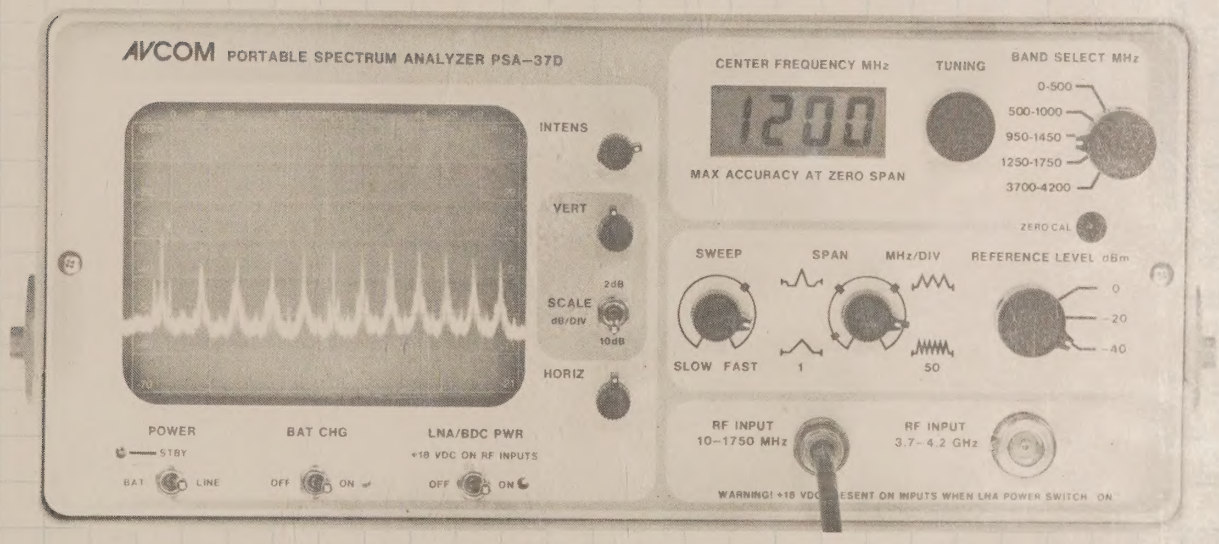
AVCOM

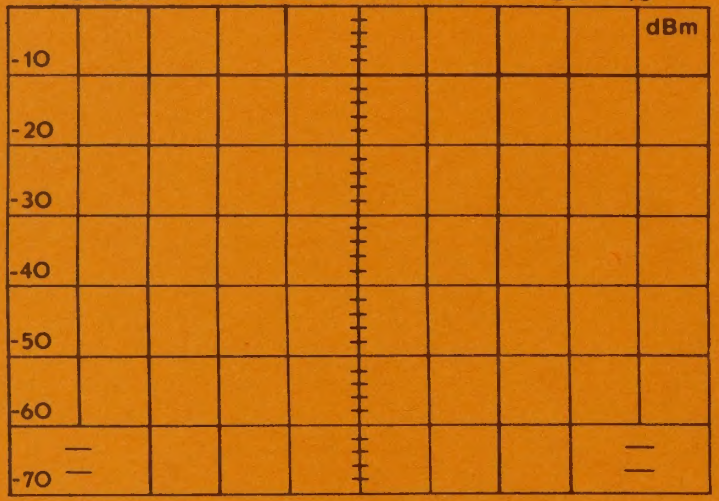
PSA-37D

PORTABLE SPECTRUM ANALYZER



OPERATION MANUAL

AVCOM PSA-35A



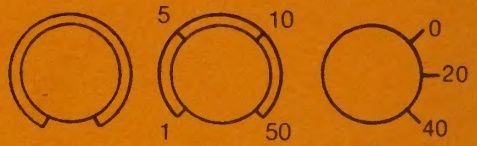
2 dB

10 dB

CONTROL KNOB SETTINGS

Mark diagram below with PSA-35A control settings:





Customer Name _____

Date: _____

System Type: _____

Installer: _____



AVCOM®
OF VIRGINIA INCORPORATED
500 SOUTHLAKE BOULEVARD
RICHMOND, VIRGINIA 23236

AVCOM OF VIRGINIA INC.
PSA USER REGISTRATION FORM

YOUR NAME _____

COMPANY NAME _____

STREET _____

CITY _____

STATE _____ ZIP _____

MODEL _____ SERIAL NO. _____

PURCHASED FROM _____

APPLICATION PURCHASED FOR _____

TYPE OF BUSINESS: DIST ☐ DEALER ☐ MANUF ☐ SERV. SHP ☐

BATTERY OPERATION NOTE

The batteries in your AVCOM Portable Spectrum Analyzer or Portable Test Receiver are gel cell lead acid type - NOT NICAD. They are similar to the battery in your car which means that "deep cycling" or total depletion may cause irreparable damage.

AVCOM recommends that anytime the PSA or PTR is operated on battery (regardless of duration) it should be fully recharged. There is not any memory problems associated with the use of these gel cell batteries.

Since the life of the batteries is greatly dependent on operator's care, they are excluded from the Limited Warranty.

PRELIMINARY OPERATING INSTRUCTIONS
FOR
AVCOM'S
PSA-37D SPECTRUM ANALYZER

BEFORE OPERATING PSA-37D SPECTRUM ANALYZER, READ THESE SECTIONS:

GENERAL SAFETY, PAGE 2
IMPORTANT CAUTIONS, PAGE 3

Foreign and U.S. patent protection for this instrument and certain unique and proprietary circuits therein is pending. AVCOM of Virginia, Inc., will take those actions necessary and permitted by law to prevent the compromise of its product designs.

IMPORTANT
READ CAREFULLY BEFORE USING INSTRUMENT

GENERAL SAFETY

ONE OR MORE COMPONENTS OF YOUR EARTH STATION IS CONNECTED TO 120 VOLT AC LINE CURRENT. IT IS IMPORTANT THAT YOU GROUND ALL COMPONENTS OF YOUR SYSTEM, PARTICULARLY THE ANTENNA, TO REDUCE THE POSSIBILITY OF DANGEROUS ELECTRICAL SHOCK.

WHEN USING INSTRUMENTS SUCH AS THE PSA-37D, POWER HAND TOOLS, AND ANY OTHER APPLIANCE CONNECTED TO AN ELECTRICAL OUTLET, EXERCISE GREAT CARE TO ENSURE THAT THE DEVICE IS GROUNDED EFFECTIVELY TO AVOID ELECTRICAL SHOCK. DO NOT USE WHILE STANDING IN WATER, ON DAMP EARTH, OR WHILE IN PERSONAL CONTACT WITH A CONDUCTING SURFACE SUCH AS A METAL LADDER OR CHAIR.

ALSO,

- USE PROPERLY GROUNDED ELECTRICAL OUTLET OR EXTENSION CORD
- DO NOT CUT GROUNDING PIN FROM LINE CORD PLUG
- USE FUSES OF CORRECT AMPERAGE
- DISCONNECT LINE CORDS WHEN WORKING INSIDE RECEIVER OR ON ANTENNA
- ENSURE THE ANTENNA AND OTHER COMPONENTS OF YOUR EARTH STATION ARE PROPERLY GROUNDED
- DO NOT SERVICE EQUIPMENT ALONE-WORK WITH SOMEONE WHO CAN ADMINISTER HELP AND FIRST AID
- PERSONS WORKING WITH LINE VOLTAGES SHOULD BE TRAINED IN AND CAPABLE OF PERFORMING FIRST AID AND RESUSCITATION TECHNIQUES

IMPORTANT CAUTIONS

1. THE PSA-37D supplies +18 VDC on the RF connectors to power most LNA's and BDC's. It is the customers' responsibility to ensure that the components being powered by the PSA-37D are compatible with +18 VDC. If in doubt, consult the manufacturer of the component.

2. Do not couple the input of the PSA-37D to high power RF sources such as walkie-talkies, CB radios, transmitters, etc. Signal levels in excess of +15 dBm can damage the sensitive mixers in the instrument resulting in otherwise unnecessary expense and repairs.

3. HANDLE WITH CARE- The PSA-37D Spectrum Analyzer is a precision instrument designed for normal operating and handling conditions. It should be protected from abuse such as dropping, throwing, and other rough handling. When being transported in a vehicle, or shipped, the PSA-37D must be cushioned and protected against shock and vibration.

4. Follow safety practices on preceding page.

WHAT IS THE PSA-37D SPECTRUM ANALYZER AND WHY DO I NEED ONE?

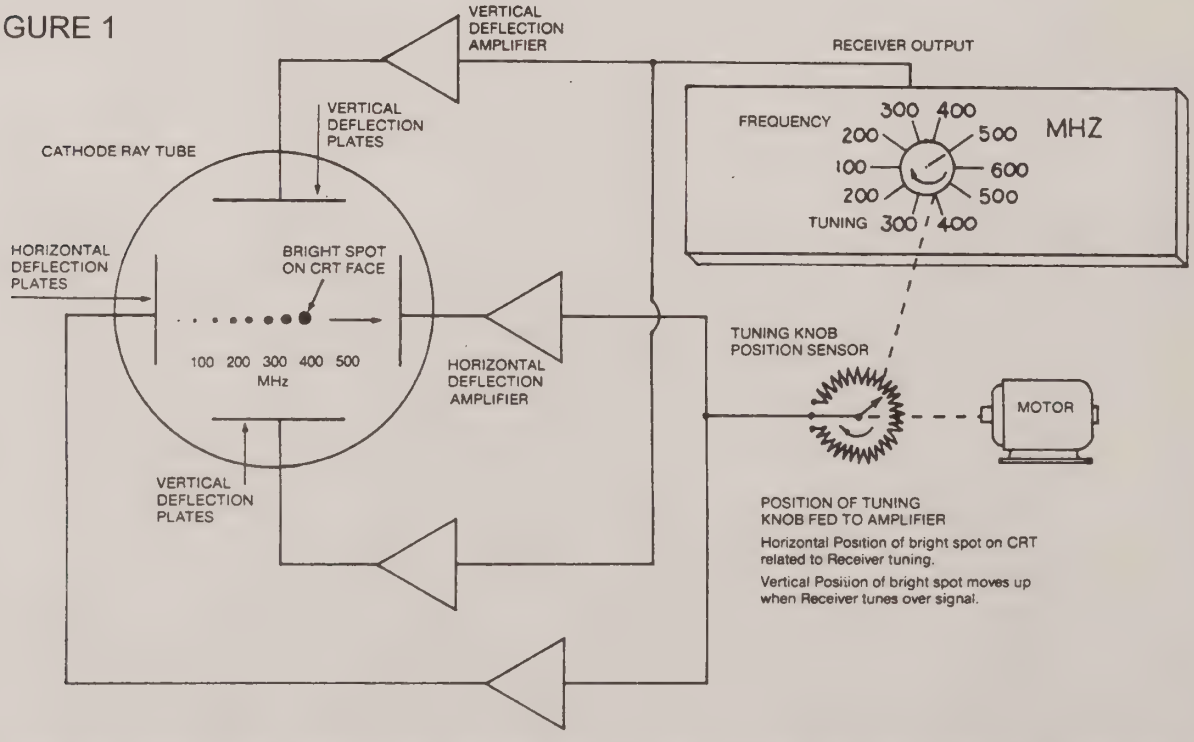
ANSWER:

Traditionally, when the words, "spectrum analyzer" are mentioned, most people think of a highly complex, bulky and heavy instrument that few people with less than an engineering degree could use, let alone understand. Until now there was some truth to this statement. But not anymore.

Avcom's PSA-37D Spectrum Analyzer has been designed to be the most versatile and useful single piece of test equipment ever available to the satellite communications industry. In short, there is not another spectrum analyzer in existence that combines the portability, ease of operation, and analytical power of the PSA-37D.

The history of the spectrum analyzer dated back to pre-World War II when radar and microwave communications were just beginning to evolve. There was a need to see on some type of display all the signals that might be present in a specific band of frequencies. A basic spectrum analyzer was built in the following way. The tuning knob of a receiver was electrically connected to a cathode ray tube so that as the receiver was tuned from the start to the end of a frequency band, the scope trace would move from the left to the right of the display. The position of the dot on the horizontal axis of the display was directly related to the frequency the receiver was tuned to at any instant. (See figure 1) The receiver was tuned over the frequency band rapidly by a motor* so that the spot would move back and forth rapidly and appear as a bright line on the face of the CRT. This is the first basic concept to understanding a spectrum analyzer.

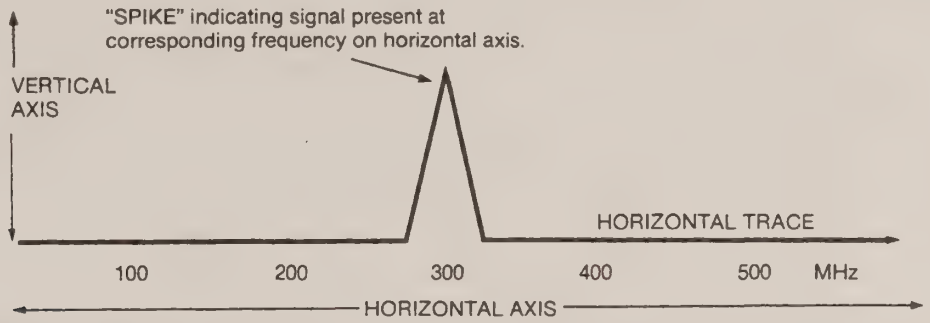
FIGURE 1



*A motor was used in this spectrum analyzer example because in the early stages of technology there was no way to sweep wide frequency ranges with purely electronic means. A motor could be attached to rotating capacitor plates and wide frequency tuning could be obtained.

We have devised a method of tracing a line on a display screen so that at any point along the line a specific frequency is defined. All that is needed now is to deflect the trace vertically when a signal is received. Where the line is deflected vertically, a "spike" will appear (See Figure 2) indicating that a signal is present at that horizontal position or frequency.

FIGURE 2



To deflect the beam vertically when the receiver is tuned across a signal, the output of the receiver was connected to the vertical deflection plates. If the receiver detected a signal, it would be amplified and cause the CRT deflection plates to bend the beam upward. If the signal were strong the reflection would be great, and much less if the signal were weak. At whatever point the beam was deflected along the horizontal axis, it would represent a signal being received at a frequency corresponding to that horizontal position. The amount of deflection or height of the spike indicated signal strength. That's all there is to a basic spectrum analyzer.

The PSA-37D Spectrum Analyzer is no different in its display. Frequency is represented by the position of the trace along the bottom horizontal scale and signal strength (amplitude) is read out by the height of the trace on the vertical scale. A few more controls and readouts are provided so that wide frequency ranges can be covered, center frequency is accurately measured and displayed, signals can be "zoomed" in on for close inspection, and very accurate amplitude measurements can be made.

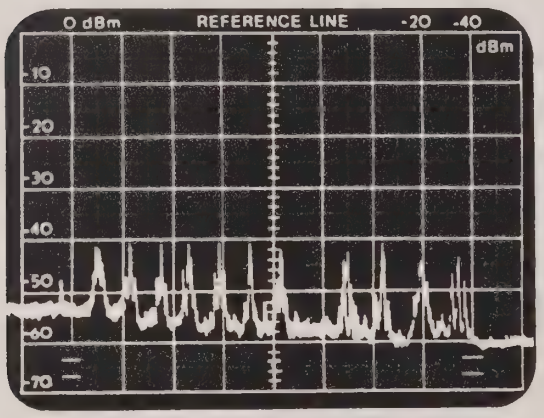
Here's good news. The controls on the PSA-37D can be mastered and basic operating procedures learned in a few minutes, Basic trouble shooting applications can be learned in a few more. Even more important is that the PSA-37D has been designed with such versatility and accuracy that it will satisfy the beginner as well as the most demanding engineer.

How can the PSA-37D Spectrum Analyzer be used in the satellite communications industry? Having a PSA-37D to look at and identify all the different RF signals on the outputs of LNA's, BDC's, downconverters, modulators, feedlines, and being able to make meaningful measurements and comparisons enable the user to quickly see and identify weak signals, signal frequency, line "tilt", missing or spurious signals, cross polarization, and terrestrial interference. Acquiring a PSA-37D is like being given a flashlight on a dark night in a field full of potholes.

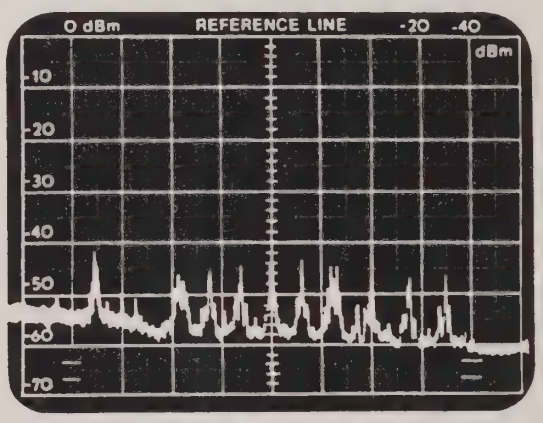
Probably the most common application for the PSA-37D is during an installation. After the dish is assembled and the LNA and/or BDC mounted, connect it to the PSA-37D. Select internal battery power and switch on the internal LNA/BDC +18 VDC. In a few seconds you will see a trace on the display. Move the antenna in the direction of the satellites and almost immediately transponders will be seen (before they would appear on a receiver-monitor). Adjust the dish for strongest displayed signals and then adjust polarization. After the first use or two you will be able to identify various satellites from the pattern of the transponders on the display. (See figure 3) Then move the dish across the arc, watching all the transponders from each satellite as you go. You will adjust the tracking faster than ever before. When your

alignment is done you can connect the receiver coax and be confident of receiving perfect pictures in your customer's house. And having a spectrum analyzer will impress and fascinate the customer. If Terrestrial Interference is present, you can show and explain it to him/her and use the PSA-37D to align the IF filters for minimum TI and best picture.

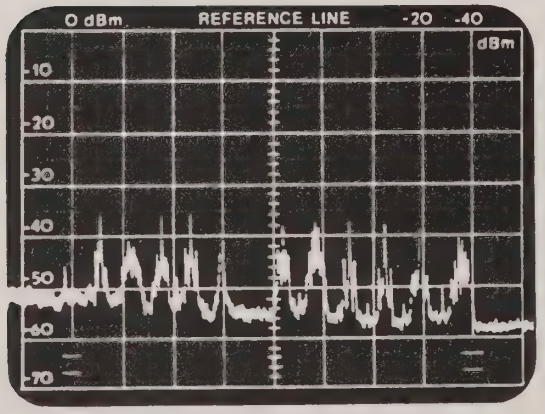
You need an AVCOM PSA-37D to enhance your ability to install and service satellite systems, to reduce time spent on elusive trouble calls, to increase customer confidence and respect, and to aid in diagnosing and resolving Terrestrial Interference problems. The time, effort, and money saved will pay for it quickly. But, maybe the best reason to own an AVCOM PSA-37D is the personal satisfaction and enthusiasm that will come from developing your technical skills and expertise as you and your business grow.



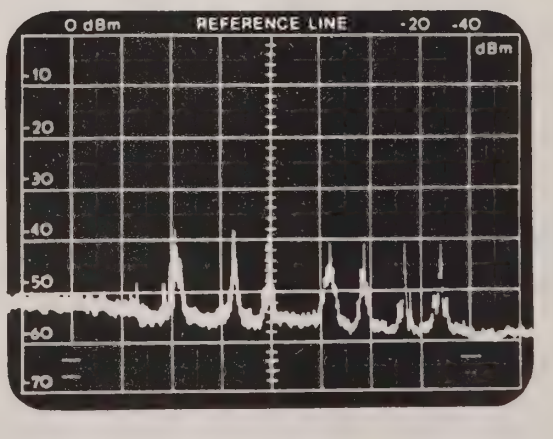
GALAXY 1
VERTICAL



SATCOM 3
VERTICAL



ANIK B
VERTICAL



SATCOM 4
VERTICAL

FIGURE 3

INTRODUCTION

The PSA-37D Spectrum Analyzer is a high performance, reliable instrument for making accurate signal strength measurements of wideband signals over the frequency range commonly used in the satellite communications industry. The unit is small and lightweight, battery-operated, or can be operated from 115 VAC, and includes its own battery recharger. Two to three hours of battery operation (depending on duty cycle) are possible.

LNA's and BDC's can be powered up the feedline via the front panel coax connectors by setting the LNA/BDC PWR switch to ON.

The PSA-37D can be used to acquire a satellite signal initially on a dish antenna and then to optimize the tracking adjustments much faster than conventional methods. Low Noise Amplifier and Block Downconverter performance can be determined instantly from the spectrum analyzer display. In fact, PSA-37D is able to clearly show the difference in the output noise levels of an LNA when it is pointed at the ground and when pointed at clear sky (a very good indication of LNA operation).

Amplitude accuracy is typically within $\pm$2 dB on each band so that meaningful and reproducible signal measurements can be taken. On-screen dynamic range is better than 60 dB.

Frequency coverage is from less than 10 MHz to over 1750 MHz and less than 3.7 GHz to over 4.2 GHz in 5 bands. Each band is designed to cover a specific group of frequencies of interest to the satellite communications industry. The PSA-37D can be tuned through the selected band and signals of interest can be centered on the display while their frequency is shown on the center frequency display. The 4 digit LCD center frequency readout allows you to quickly and correctly identify the frequency in MHz of a signal centered on the PSA-37D display.

AVCOM's PSA-37D



LOCATION AND FUNCTION OF FRONT PANEL CONTROLS

(Refer to diagram on opposite page)

1 POWER

Bat - turns instrument on and instrument is powered by internal rechargeable battery

STBY - Amber LED is illuminated if line cord connected to source of 115 VAC. Instrument is functionally off although power is present inside chassis.

Line - turns instrument on and power is from 115 VAC line source.

2 BAT CHG

Battery is connected to internal charging circuit when switch is on the ON position. Amber LED is illuminated while battery is recharging.

3 LNA-BDC PWR

When in the ON position, +18 VDC is applied to the input connectors so that LNA's and/or BDC's can be powered via the feedline. The red LED is illuminated when +18 VDC is present on the connectors.

4 INTENS

Controls the brightness of the display

5 VERT

Controls the vertical position of the trace

TO SET: With no signal input and "Reference Level" control set of 0 dBm, the trace should be adjusted to be between the 2 small "tic" marks between -60 and -70 dBm at the bottom of the display.

6 SCALE

Used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV. The 2 dB position is particularly helpful for peaking the antenna and feedhorn.

7 HORIZ

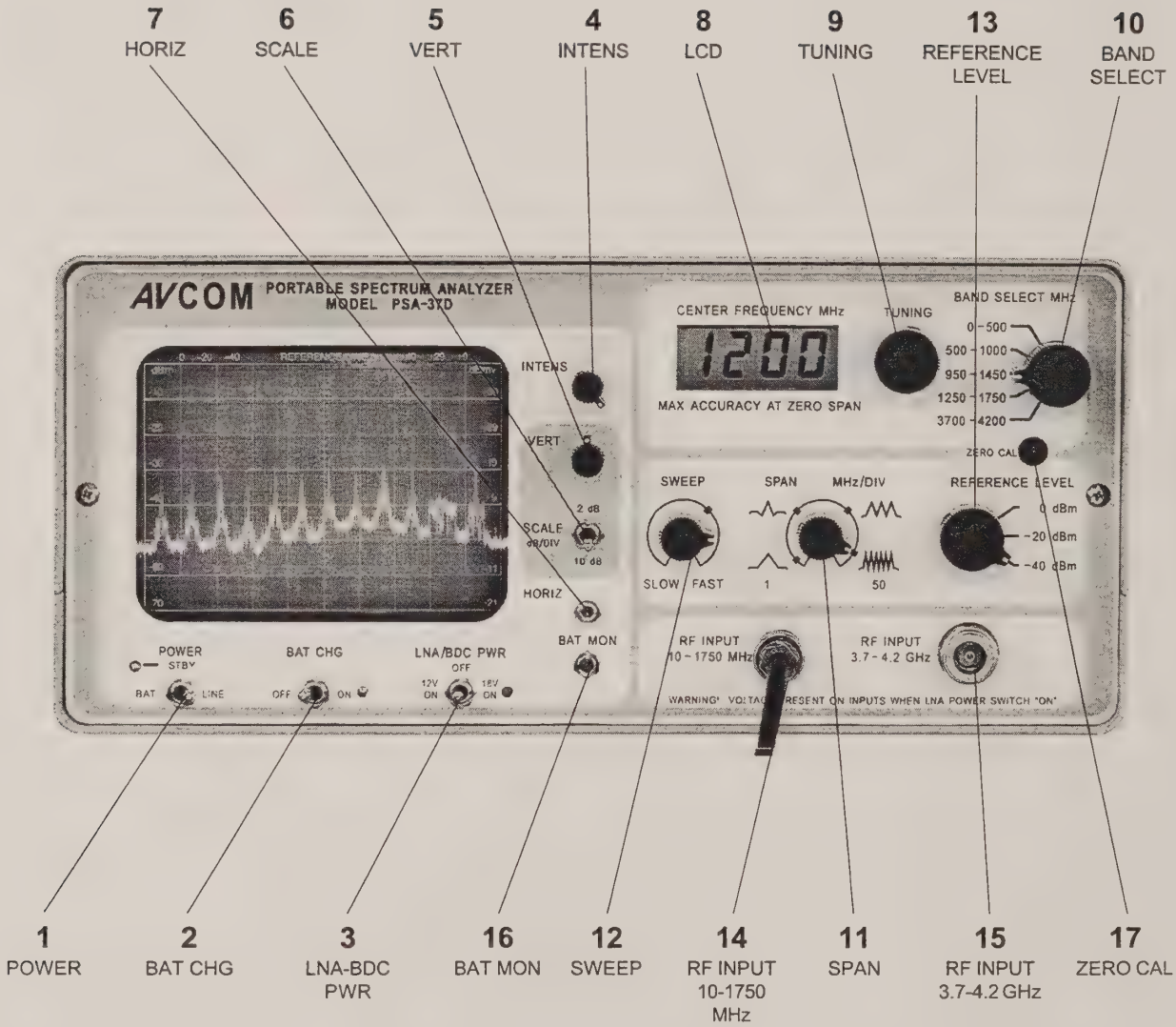
The HORIZontal position control is a recessed pot that is factory set but is accessible to the operator with the use of a plastic tuning tool. In general, the HORIZ should not need to be adjusted in the field. HORIZ positions the trace horizontally on the screen so that if a signal is placed at the center of the display and the span control turned counterclockwise for a closer look at the signal, the signal remains at the center of the display and the CENTER FREQUENCY should remain the same.

TO SET (if the situation warrants): Using SPAN and TUNING controls, expand on a signal turning SPAN counterclockwise while keeping signal on screen with the TUNING control. Then turn SPAN clockwise while observing the signal. Adjust HORIZ to position the signal on the centerline of the display. Repeat one time.

8 LIQUID CRYSTAL DISPLAY

The 4 digit LCD currently has 2 functions but additional features may be added in the future. The LCD allows you to read the frequency of a signal centered on the PSA-37D graticule. When the BAT MON button is depressed, the DC voltage of the internal battery pack is displayed.

AVCOM's PSA-37D



9 TUNING

Tunes the PSA-37D through the selected band and centers signals of interest on the display while their frequency is shown on the CENTER FREQUENCY LCD display.

10 BAND SELECT

Selects the frequency range of interest to be displayed on the Spectrum Analyzer. Frequencies from less than 10 MHz to more than 1750 MHz and 3.7 to 4.2 GHz can be displayed.

11 SPAN

Controls the sweep width of the Spectrum Analyzer. When fully clockwise, signals in the entire bandwidth of the selected band are displayed. Then, if a smaller area of that spectrum is to be examined, the area is centered over the vertical centerline with the CENTER FREQUENCY control and the SPAN control turned counterclockwise to see the signal more closely.

12 SWEEP

Controls the rate the trace moves over the display. For general observation, a sweep rate just fast enough that "trace flicker" almost disappears should be used. For the accurate amplitude and signal measurements the PSA-37D is capable of, the sweep rate should be slowed down until the signal is at maximum display amplitude. Generally, the sweep should not be set at its fastest rate (fully clockwise).

13 REFERENCE LEVEL dBm/dBmv

The Reference Level control establishes the amplitude calibration for the display. When set at the 0 dBm position, with the scale switch in the 10 dB/DIV position, signals peaking at the 2nd line from the top, the -10 dBm / + 49 dBmv line, would have a strength or amplitude of -10 dBm / +49 dBmv, signals peaking at the -20 dBm / +29 dBmv line would have a signal strength of -20 / +29 dBmv, dBm and so on.

When the Reference Level control is set to -20 dBm the very top line represents an amplitude of -20 dBm / +29 dBmv and the second line down would be -20 dBm minus 10 or -30 dBm (+29 dBmv minus 10 equals +19 dBmv) subtract 10 for each line down to get the signal level represented by that line.

The same is true for the -40 dBm position except that -40 dBm / +9 dBmv signals would be at the top line. This is the most sensitive position and signals as weak as -90 dBm can be seen.

14 RF INPUT 10-1750 MHz

The BNC connector accepts signals to be displayed from less than 10 MHz to over 1750 MHz.

15 RF INPUT 3.7-4.2 GHz

The type N connector accepts signals from 3.7-4.2 GHz for display on the CRT.

16 BAT MON

When the BAT MON button is depressed, the voltage internal battery pack is displayed on the LCD.

WARNING-DO NOT APPLY SIGNAL STRENGTHS GREATER THAN +15dBm OR INPUT MIXER MAY BE DAMAGED!

17 ZERO CAL (Recessed Pot)

Allows for adjustment of the digital meter reading. It adjusts the readout of all five bands by +/- 10 MHz to compensate for temperature drift.

NOT PICTURED

HORIZONTAL DISPLAY REVERSING SWITCH (located on underside of PSA-37D chassis). In most applications this switch will be left in the "NORMAL" position. However, certain block downconverters have an inverse input-to-output frequency relationship; that is, for example, an input of 3.7 GHz comes out of the BDC at 1450 MHz and an input signal of 4.2 GHz comes out at 950 MHz. While looking at the output of a BDC of this type with the PSA-37D Spectrum Analyzer, placing the Horizontal Display Revesing Switch in the "REVERSE" position will give a display that most users are used to seeing; that is, lower number transponders on the left and higher number transponders on the right of the PSA-37D screen, even though the frequency relationship is reversed.

OPERATION

Preliminary Checkout and User Familiarization

IMPORTANT: The batteries in your AVCOM Portable Spectrum Analyzer are gel cell lead acid type - NOT NICAD. They are similar to the battery in your car which means that "deep cycling" or total depletion may cause irreparable damage. AVCOM recommends that anytime the PSA-37D is operated on battery (regardless of duration) it should be fully recharged. There is not any memory problems associated with the use of these gel cell batteries. Since the life of the batteries is greatly dependent on operator's care, they are excluded from the Limited Warranty.

1. Place POWER switch into STBY position.
2. Plug PSA-37D into line socket (115 VAC).
3. Note that amber STBY LED is illuminated.
4. Turn BAT CHG to ON and note that amber LED is illuminated.
5. Turn POWER switch to ON. Turn INTENS control 80% of full clockwise position. Center VERT. After 30 seconds a trace should appear on CRT.
6. NOTE: In this step +18 VDC will be applied to input connectors. Make certain that nothing is connected to them.
 Place LNA/BDC PWR switch in ON position. Note red LED lights indicating that +18 VDC is available on RF connectors.
7. Turn LNA/BDC PWR switch off.
8. Set up instrument as follows:
 BAND SELECT: 0-500 MHz Band (first position)
 CENTER FREQUENCY: Use TUNING to set frequency at 100 MHz
 SWEEP: set at 1 o'clock
 SPAN: fully clockwise
 REFERENCE LEVEL: 0 dBm
 SCALE: 10 dB/DIV(down position)

9. Adjust VERT control to position trace between the two short "tic" marks in the bottom left graticule square (between -60 and -70).
10. Note that a large signal is visible on left of display. This is normal for all spectrum analyzers and is called ZERO FREQUENCY. Small spurious signals are present around it.
11. Using the TUNING Control, place the Zero Frequency signal in the center of the display.
12. Turn the SPAN control slowly counterclockwise to expand the signal, while keeping it centered with the TUNING control. Expand the large peak significantly and center it.
13. The HORIZ position control is not normally used in the field however if the PSA-37D seems to be out of calibration, the following procedures may be helpful. Turn the span control full clockwise and do not touch the TUNING control. If the HORIZ control is not calibrated the peak will shift to the right or left of the vertical centerline. Use the HORIZ control to move it back to the center line.
14. Repeat steps 12 and 13 to verify adjustment is correct.
15. To check that the sensitivity of the instrument can be changed with the REFERENCE Level control, observe the ZERO FREQUENCY peak and turn REFERENCE LEVEL to -20 dBm. The peak should become larger. Then turn REFERENCE LEVEL to -40 dBm. The little peaks to the sides of the main peak should become higher and the main trace should become noticeably noisy.
16. Note position of VERT and INTENS knobs so PSA-37D can be put into service rapidly the next time it's used.
17. This completes the User Familiarization and Preliminary Checkout procedure.

SPECIFICATIONS

Frequency Coverage

Low Bands: a) less than 10 to 500 MHz (70 MHz and other receiver IF frequencies)
b) 500 to 1000 MHz (3.7 to 4.2 GHz and 12 GHz block downconverter frequencies - pertains to frequencies b-e)
c) 950 to 1450 MHz
d) 1250 to 1750 MHz
High Band: a) 3.7 to 4.2 GHz

Input Connectors

Low Band: BNC (type F to BNC adapter included)
High Band: type N

Input Connector DC Block Capability -- Both input connectors are DC blocked and provision is made for insertion of +18 VDC into connector by front panel switch.

Frequency Display Accuracy - 4 digit LCD frequency readout - Accuracy +6 MHz nominal, at zero span.

Display - 10 horizontal graticule divisions (frequency) x 7 vertical graticule divisions (amplitude). Each vertical division equals either 2 dB or 10 dB.

Reference Levels - 0, -20, and -40 dBm/+49, +29, and +9 dBmv

Dynamic Range - 60 dB

Display Sensitivity - 2 dB/DIV or 10 dB/DIV

Amplitude Accuracy - $\pm$2 dB, typical per band

Resolution Bandwidth - 250 KHz

Calibration - internal calibration, factory set

Span - Over 500 MHz (50 MHz/DIV) to less than 1 MHz/DIV

Weight - 17 lbs. / 7.72 Kg

Dimensions - 14.5"W x 5.5"H x 13.5"D, 37 cmW x 14 cmH x 34 cmD.

Circuitry - Most circuitry on pluggable PC boards for rapid and easy service.

Construction - Attractive and durable epoxy painted heavy gauge aluminum chassis and cover, with carrying handle, and line cord storage brackets which double as feet to stand the PSA-37D on end for easy viewing and operation in the field.

Power Requirements - 115 VAC, 60 Hz, 65 watts or internal rechargeable batteries for portable operation. 220/240 volt model available.

BATTERY OPERATION NOTE

The batteries in your AVCOM Portable Spectrum Analyzer are gel cell lead acid type - NOT NICAD. They are similar to the battery in your car which means that "deep cycling" or total depletion may cause irreparable damage.

AVCOM recommends that anytime the PSA-37D is operated on battery (regardless of duration) it should be fully recharged. There is not any memory problems associated with the use of these gel cell batteries.

Since the life of the batteries is greatly dependent on operator's care, they are excluded from the Limited Warranty.

Design and specifications subject to change without notice

SASAR INTRODUCTION

Spectrum Analyzer System Analysis Report

The SASAR is an invaluable tool to assist the installer and service personnel and to establish their credibility and reinforce customers' confidence. The SASAR contains a record of all signal strength readings taken with a PSA-37D Spectrum Analyzer that are available from LNA to the receiver. If a problem should arise in the future involving video quality or other system performance problems, and the solution isn't obvious, the SASAR should be consulted and the measurements taken again. The installing dealer should give a copy to the customer and keep a copy on file.

Many problems will fall quickly to the serviceman equipped with a PSA-37D. Some that could take many hours will be obvious at a glance of the display.

At the end of this manual is the SASAR. Copies may be made for users of the PSA-37D.

SASAR - pronounced "SAY-SAR"

INTRODUCTION TO APPLICATION SECTION

The following Application Section presents a series of checks and tests to familiarize and teach the principles and usage of the PSA-37D Spectrum Analyzer. The section should be read by everyone who will use the PSA-37D since may subtle points are made and by practicing the examples, many questions will be answered.

AVCOM solicits your own applications and suggestions. Use the form and envelope at the last page of this manual and mail to: AVCOM, 500 Southlake Blvd., Richmond, VA 23236.

Application Example #1

Observing Output of LNA at Dish for Testing and Dish Alignment

One of the most useful and easiest applications of the PSA-37D Spectrum Analyzer is to use it to look at the signal spectrum coming from the LNA on a satellite dish. By observing the output of the LNA, satellites can be found more quickly than with a receiver (signals show up on a spectrum analyzer before they can be seen on a receiver), the feedhorn polarization can be optimized, the dish can be adjusted to track the satellite belt and any spurious or interfering signals such as Terrestrial Interference can be seen.

As an exercise, connect the PSA-37D to a dish and LNA and become familiar with what satellite signals look like and how the controls of the PSA-37D are used.

Equipment Required:

- TVRO Dish
- LNA and Feedhorn
- PSA-37D Spectrum Analyzer
- Feedline with type N connectors about 12" long

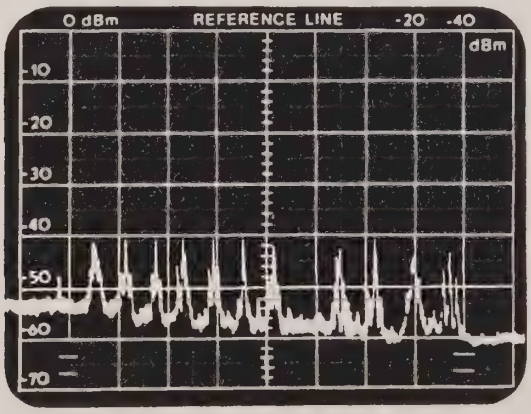
Connect LNA to PSA-37D Spectrum Analyzer with the feedline pigtail. (CAUTION: Make sure type N connectors on feedline are in good condition so PSA-37D connector is not damaged.)

Set up PSA-37D as follows:

INTENS and HORIZ - as in checkout section
CENTER FREQUENCY - 3950 MHz
BAND SELECT - 3700-4200 MHz
SWEEP - 1 o'clock position
SPAN - fully clockwise
REFERENCE LEVEL - -20 dBm
POWER - ON (either BAT or LINE)
BAT CHG - N/A
LNA-BDC PWR - ON
RF INPUT - 3.7-4.2 GHz, connect to LNA

After 15 seconds or so, the display trace should appear and if the dish was pointed at a satellite, transponders should be seen as in the figure at the bottom of this page.

1. Take a moment to vary each control to see its effect on the display.
2. Choose a transponder, place it in the center of the display and expand it to fill the entire display. Return controls to normal.
3. Move the dish and watch the amplitude of the transponders increase and decrease.
4. Rotate the polarization of the feedhorn and note opposite polarization transponders coming up between the others. This is a great way to see if a feedhorn is working properly.
5. Set the REFERENCE LEVEL control to -40 dBm and note height of display. Leave it on the setting that is most comfortable for you.
6. Measure the output of the LNA for future reference and draw the way the transponders appear for that satellite and polarization. Note the REF setting. Slow down the SWEEP rate for accurate amplitude measurement and note signal levels of a low, middle, and high end transponder. Rotate feedhorn and make measurements for the opposite polarization.
7. If time permits, sketch the transponder pattern for Galaxy, Satcom F3, and Satcom 4. These sketches will be useful later when you wish to identify which satellite the dish is pointed at without having to connect a receiver for visual identification.



GALAXY 1
VERTICAL

Application Example #2

Feedhorn Cross-Polarization Performance and Evaluation
(Additional practice and familiarization with the PSA-37D)

When you performed Application #1, you noticed how the transponders appear as the feedhorn is rotated. As the feedhorn or its polarizer is rotated, one set of transponders will increase to maximum as the other set gets weaker, then as the feed is rotated further, the stronger set becomes weaker and the weaker ones get stronger. The position of the polarizer where each set of transponders is most weak is the null point. It is easier to peak the feed by looking at the nulled transponders (or the absence of them, as they disappear into noise, then it is to peak on the strongest signals). We also know that by rotating the feed 90 , the transponders that were weakest now become strongest and vice versa.

While working with the PSA-37D Spectrum Analyzer, it has been noticed that some brands of feedhorns may not be tuned or constructed properly to give adequate rejection of the opposite polarity to which they are positioned. This gave the idea for a good practice and learning application for the PSA-37D. Many manufacturers claim 30 dB or more cross-polarization rejection or isolation. This is probably much more than is needed for any earth station application that we might encounter. If you can still see the opposite polarization after you have nulled it out as much as possible; that's bad! Such poor performance can result in noticeable picture quality degradation and chances are you or the customer will attribute the problem to some other factor such as the dish or receiver threshold performance.

How to test for poor feedhorn cross-polarization isolation
(Use same test setup as in Application #1)

CAUTION-When performing this test we must be sure to avoid closely spaced satellites to test on because if the dish is picking up two satellites at one time (one weak and the other strong) it could be easily confused with poor feedhorn isolation.

A pretty good satellite to test on is ANIK B. Westar 3 is fairly far away and not much is coming off the old ANIK bird. Whatever satellite you use, verify that adjacent satellites aren't too close and that the one you've picked is strong. (Use the PSA-37D to do this.)

The test is easy. Rotate the feed while watching the weak transponders begin to null out. Null them as much as possible. If they disappear, the feedhorn should give good performance as far as cross-polarization goes. If you can't get them to null out, well, you better get in touch with the manufacturer. Check first that it isn't interference from another satellite. Move the dish a little up and down to see if its being caused by another bird. If the answer is no, make this check. Note which transponders are nulled the best. Then rotate the feed very slightly and see if the null improves for the ones that were the worst and gets worse for the ones that were best. If so, it indicates that the polarizer is frequency sensitive, i.e., the skew will be different for lower numbered transponders than higher ones.

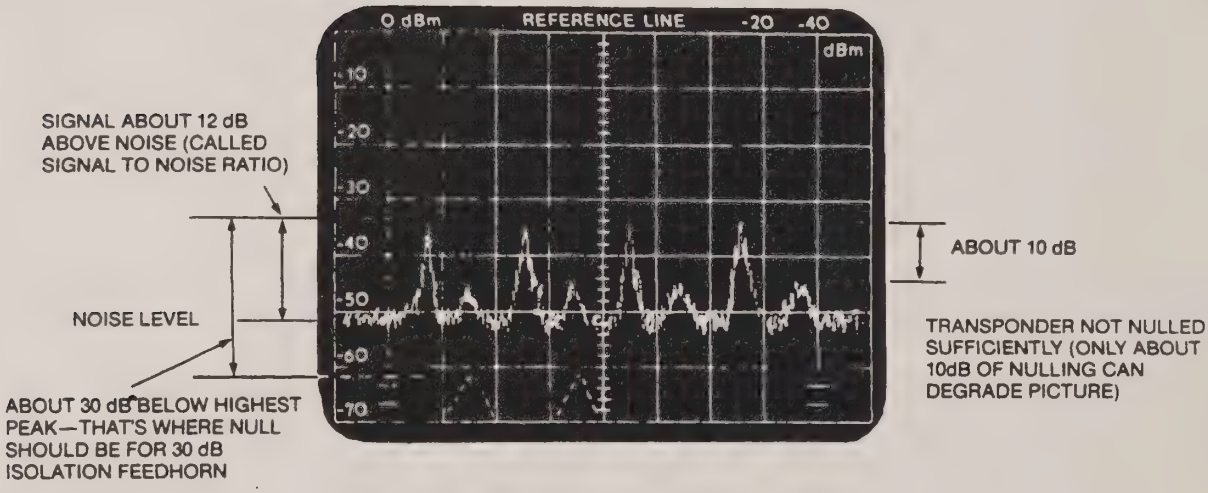
Be sure and use the SPAN and TUNING controls to expand the display to look at just a few transponders at a time and more carefully. Slow the sweep down for accurate amplitude measurements.

If you have a questionable feed, swap in another one and maybe try a different brand for comparison.

Note that this test can't resolve feedhorn isolation greater than the signal to noise ratio* of the satellite transponder. But as long as the transponder can be nulled into the noise far enough that we can't see it, we're O.K. (see Figure 1)

This application should have given considerable insight and practice with the PSA-37D.

FIGURE 1



IN THIS FIGURE, A FEEDHORN WITH 30 dB OF ISOLATION WOULD NULL THE SIGNAL OF OPPOSITE POLARIZATION DOWN TO THE DOTTED LINES.

*Signal to noise ratio means the difference between signal power and the noise level usually expressed in dB. A spectrum analyzer does not average the signal power in a given bandwidth so it can't be used for absolute measurements. A laboratory grade power meter such as the HP436A would be used. With experience though, a spectrum analyzer can give an excellent "feel" from which comparisons can be made.

Application Example #3

Block Downconverter Flatness Check and
Testing for Proper BDC Signal Distribution Levels

When using block downconverter receivers there are two important considerations for good system performance.

1. That the output of the block downconverter is fairly flat (see front cover of this manual a display from an AVCOM BDC-60 after passing through 200 feet of RG-59. With control settings as in picture, reference line = 0 dBm, the signal output is a healthy -40 dBm).
2. That the cable used and splitters etc., don't introduce so much loss in parts of the band, that compensating amplifiers amplify too strongly one part of the band and overdrive the receiver while starving the receiver in another portion of the band.

The PSA-37D enables the feed into the receiver to be evaluated at a glance. Above problems will stick out like a sore thumb.

ACTIVITY A

Look at the output of the BDC before signal is distributed to receivers.

Equipment Required:

TVRO Dish

LNA and BDC or LNC

PSA-37D Spectrum Analyzer

Connect a LNA to the BDC. Then, connect the BDC to the PSA-37D.

CAUTION: The LNA/BDC power switch causes +18 VDC to be applied to front panel connectors. Be certain that this power is compatible with your LNA and BDC.

Use the BNC to F adapter supplied with the instrument and use 6-10 foot jumper of RG-59 to connect the BDC and PSA-37D.

Flip on LNA/BDC power and make sure red LED is glowing (if not check for shorted RG-59 cable).

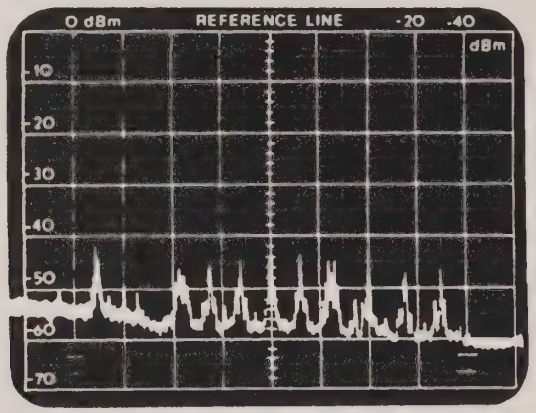
Adjust BAND SELECT switch to be compatible with output frequency of BDC. For example, if you are using an AVCOM BDC-60, Scientific Atlanta or Microdyne BDC, use the 500-1000 MHz position. DX BDC's operate from 950 to 1450 MHz. Select the correct range. If you're wrong it will be apparent since the transponders won't fill the display nicely with the CENTER FREQUENCY display centered.

IMPORTANT NOTE: Some imported and other BDC's have their local oscillator injection above 3.7-4.2 GHz. This causes the output frequency to be inverted. On a spectrum display transponder 1 will be on the right hand side of the display, transponder 24 on the left. Check manufacturer's data sheet to determine if the BDC you're using has frequency inversion. (If its LO frequency is greater than 4.2 GHz, it does.) Compare the output of a LNA for a given satellite to the output of the BDC on the same satellite. If the presentation is reversed (missing transponders, etc.) you know the answer.

Set SWEEP RATE just above the "flicker rate" and set SPAN for the whole band, fully clockwise.

Set the REFERENCE LEVEL to put transponders near center of display (as far as vertical positioning is concerned; and you should have calibrated the instrument per Operation section of this manual before starting Application).

Look at the display. It should be similar to the photo.



SATCOM 3
VERTICAL

You can see that the transponders are all fairly equal in height and that the noise line is also fairly constant in amplitude across the band. That's the output of a good (flat) BDC. If the BDC is poorly designed or defective, you will see gross variations in signal and noise line amplitudes.

Here's an important point. Both the amplitude of the transponder and the amplitude of the noise level give us important information. Be sure to pay attention to both as you learn to use the PSA-37D. Also pay attention to the height of the transponder above the noise level. Generally there should be not more than a few dB difference. Too little to be terribly significant when looking at a rapidly changing transponder signal. If there's a very noticeable difference from one end of the band to the other, there's probably something wrong with feedhorn, LNA or BDC. Remember to slow the sweep down and expand the display when recording the actual signal output level from the BDC. (And don't use the Sweep Rate set at full clockwise position. That's too fast. Should never be used that way!)

It's a good idea to record the output level from the BDC. Note setting of REFERENCE LEVEL switch.

ACTIVITY B
Testing the BDC signal after passing through all the distribution components.

Take the PSA-37D to the receiver location and connect it to the BDC feed. Look at the way the signal differs from the way it looks at the BDC. (Power the BDC via PSA-3D of if by another receiver, be sure +18 VDC is turned OFF.) You should see some signal tilt if the coax run is very long and probably some high frequency roll-off if many signal splitters are used.
If you suspect that a component isn't functioning correctly, connect it directly to the BDC with a short jumper and to the PSA-37D. Problems and bad components can be quickly isolated in this manner.

Record the level going into the receiver. Slow down the sweep for accuracy when reading the level.

Application Example #4

Sweep Office or Home for Hidden Transmitter

1. Take phone off hook and/or play radio to activate sound activated type device.
2. Set the PSA-37D Spectrum Analyzer to the 10-500 MHz range. Connect a portable whip antenna to the BNC input.
3. Walk to a different room and observe the display on the PSA-37D. Signals will be seen. Note their position and amplitude. These will be FM and TV stations, two way radios, etc....
4. Walk toward the area suspected of having a hidden transmitter while watching the PSA-37D display for a signal that starts very small and grows larger as you as you move. Home in on the signal source by moving in directions that tend to make the signal spike grow larger.
5. Verify that the signal is not a legitimate one by walking away from the area. If the signal fades when walking away from target room in different directions and grows as you return, the room is probably "bugged". You can also hang up the phone and/or silence the room to see if the signal "spike" disappears, indicating transmitting stopped.
6. Continue to home in on signal reducing the sensitivity of the PSA-37D as you get closer to the suspected transmitter.
7. After homing in on the transmitter as much as possible, begin physical search. You should be able to localize the suspected transmitter to within a few feet, the physical search should be fruitful in moments.

Application Example #5

Detect a Breach of Radio Silence in a Remote Area

1. Set the PSA-37D Spectrum Analyzer band select switch to the 10-500 MHz band.
2. Connect a wide band antenna to the 10-1500 MHz input. Observe display and note signals present.
3. If a transmitter is activated nearby, a large "spike" will be seen on the PSA-37D display.
4. Standard procedures can then be followed to intercept the signal on a communication receiver.

Application Example #6

Viewing DSS DBS Satellite Signals on the PSA-37D Spectrum Analyzer

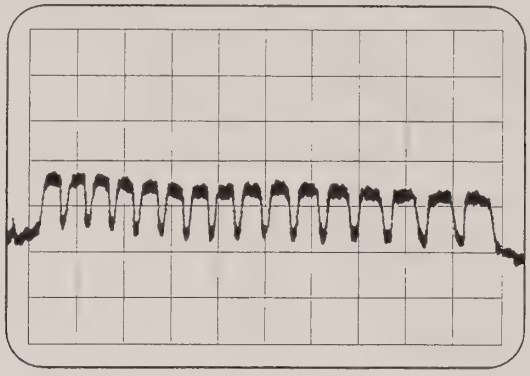
DSS signals from the DIRECTV-HC5 spacecraft can be seen with AVCOM's PSA-37D Portable Spectrum Analyzer. The HC5 satellite has 16 transponders transmitting at 12.2-12.7 GHz. These transponders are centered 500 MHz above the "standard" Ku satellite band (11.7-12.2 GHz) and normal "USA" Ku LNBs will not convert the DBS transponders to the 950-1450 MHz block. However, most of the transponders can be seen with a standard LNB by setting the PSA-37D to the 1250-1750 MHz band and tuning to a center frequency of about 1650 MHz.

The output of the DSS LNB is in the 950-1450 MHz band because its internal local oscillator is tuned to 11.250 GHz, 500 MHz above the "normal" LNB. AVCOM can furnish Ku LNBs modified for 12.2-12.7 GHz operation for $235.00 (circular polarized feed extra for $125.00).

The figure below shows the DIRECTV-HC5 satellite's 16 Ku transponders with 24 MHz channel bandwidths. The transponders are *circularly* polarized.

DSS Signals shown on a PSA-37D

This pattern (as of 7/27/94) may change with the launch of another satellite in early August '94 which is to be co-located in orbit with the existing spacecraft.



PSA-37D display of DIRECTV-HC5 using 18" RCA offset feed antenna and DSS LNB, 50' of RG-59 coax, and with the following PSA-37D settings: BAND SELECT - 950-1450 MHz, CENTER FREQUENCY - 1200 MHz, REFERENCE LEVEL - -40 dBm

WARNING: Before you connect the PSA-37D to any LNB, it is your responsibility to make sure the LNB is rated for +18 VDC. One way to check might be to measure the voltage provided by the receiver for the LNB.

The HC5 spacecraft transponders are very powerful having an EIRP of 53 dBw. Our experiments show that the 18" offset dish can be more than 50% covered with black conductive foam and the DSS receiver will still lock on and function. Also we have received video through a single pane of glass but if the need arises to put the dish indoors behind heavy or thermopane windows, it may be necessary to use a larger dish, about 24" to 30". The original LNB could be used and mounted at the focal point of a larger offset feed type antenna. For a round parabolic antenna, AVCOM can supply an LNB and feed modified for circular polarization.

In our experiments, it seems that with S/N ratios below about 25, as indicated in the setup program of the DSS receiver, the picture will drop out of lock for fractions of a second as observed on the C-SPAN and Weather channels (channels we were using for test). This was while receiving the signal through a single pane glass window with a 30" dish and a linearly polarized LNB and may not be true in other situations. (The dish was partially masked by the windowframe). When we switched to a circularly polarized feed, the signal improved dramatically from about 25 to 35. There was a tree branch in the path of the signal about 75' away so we moved to an adjacent window and the signal jumped to about 60. There seems to be some effect on signal strength with the distance of the dish to the glass surface but we do not fully understand it.

Those attempting more creative DSS dish installations (inside buildings, looking through sparse foliage, using smaller antennas than the 18" offset supplied, or concealed installations) where the signal obtained is not optimum or there is uncertainty where to point the dish, may find it difficult to use the receiver's built-in alignment program because it may not have been intended for such applications. If the installer has an AVCOM PSA-37D spectrum analyzer the signal can be very quickly located and measured even though it is below the

receiver's signal strength requirement and steps can be taken to improve the signal by larger antenna or relocation. For the experiments we just did we would have been unable to acquire the satellite through the windows and trees without the spectrum analyzer and from time to time when the tripod was bumped the only way that we could reacquire the signal was to go back to the spectrum analyzer which then took a few seconds.

In the short time that we have had the DSS system we are very impressed with its performance and consider it to be one of the most exciting things to happen in the history of the satellite industry. C-Band systems are still desirable and have a solid position in the marketplace because of the vast programing available (both free and subscription). The DSS system can't be beat for portability, ease of use and opportunity for creative installations.

Some of you installers have said that you don't need a spectrum analyzer anymore but wait until you go to a customer whose house or apartment is in the middle of trees or whose covenants prohibit a dish to be visible.

What appears to be an impossible installation may become doable, and hours can be turned into seconds with the use of an AVCOM PSA-37D Portable Spectrum Analyzer and site survey horn. Optimum dish location through holes in trees can be quickly found using AVCOM's PSA-37D and Ku survey horn (PKSA-12).

This technology gives you a whole new opportunity to generate income and you may want to ally yourself with a tree trimmer to snip just the right opening in the trees (and you probably won't be able to find the spot without an AVCOM spectrum analyzer).

LATE NOTES:

It seems that our DSS LNB requires at least +18 VDC for operation. When the battery of the PSA-37D gets a little weak (below +18 VDC), our DSS LNB stopped operating. Its noise level stayed high but the transponder signals went away which fooled us into thinking that it was still operating and the dish was off of the satellite. We switched the PSA-37D to line power and the signal reappeared.

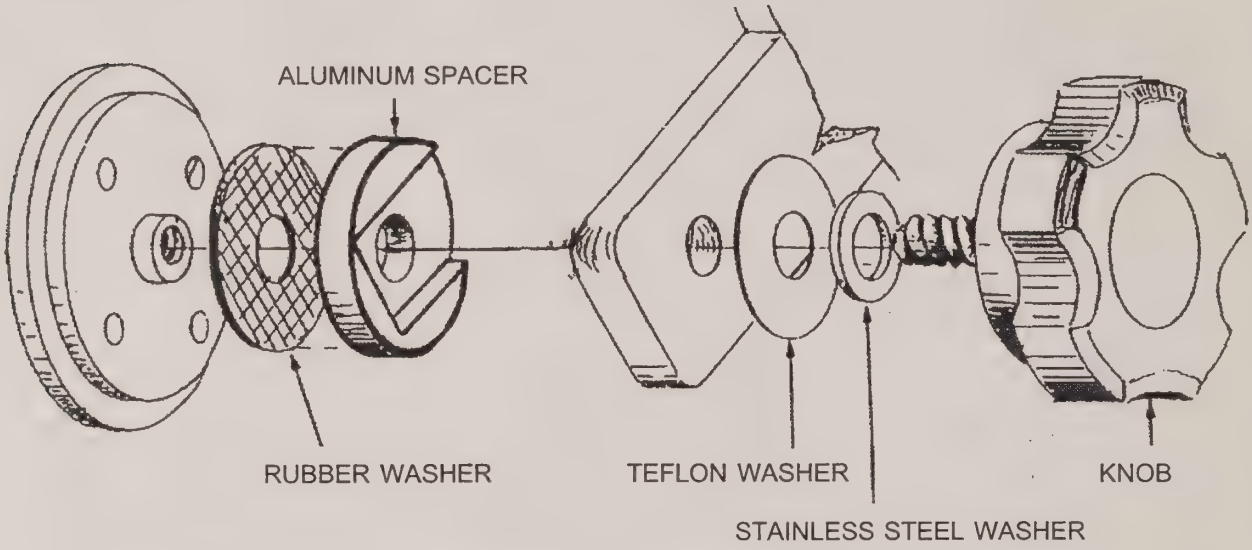
We placed a single pane storm window in parallel with existing window and signal dropped off from about 60 to 25. System would lock up but Weather channel was out of lock 10% of the time. At this point no effort was made to optimize other than realign the dish.

There may be some phase cancellation between the panes of glass and there may be an optimum spacing of the parallel panes of glass based on a multiple of the Ku band wavelength. (By holding the piece of glass in front of the feed and moving it closer and farther, signal strength varies based on some wavelength relationship).

BAIL HANDLE ASSEMBLY SEQUENCE

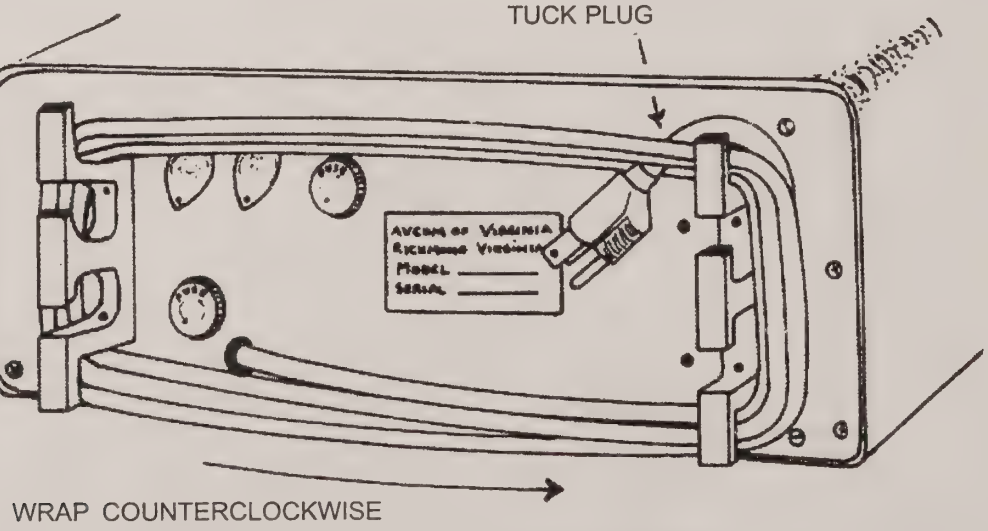
The bail handle friction knob must be assembled in the order shown below. The order of parts are (1)knob, (2) stainless steel washer, (3) teflon washer, (4) bail handle, (5) aluminum spacer and (6) rubber washer.

There are two of these assemblies mounted to either side of the chassis. If they are not attached in this way, the handle may not function properly as a prop stand.



CORD WRAP PROCEDURE

1. Wrap power cord in a counterclockwise direction around cord guides. Only top and bottom hooks of cord guides are to be used.
2. Tuck plug behind outermost strands of wrapped cord.



PSA-37D - REAR PANEL VIEW

LIMITED WARRANTY

AVCOM OF VA, INC. warrants to the original purchaser that this spectrum analyzer shall be free from defects in workmanship for one hundred eighty days from the date of original purchase. During this warranty period AVCOM OF VA, INC. will provide free of charge both parts and labor necessary to correct defects in workmanship.

AVCOM OF VA, INC. additionally warrants to the original purchaser that this product shall be free from defects in material until one year after the date of original purchase. During this additional warranty period, AVCOM OF VA, INC. will provide free of charge the parts necessary to correct defects in material. Labor charges are not included and will be based on current rates if product diagnosis, repair, alignment, or inspection is required.

THIS WARRANTY DOES NOT INCLUDE batteries or cathode ray tubes. AVCOM OF VA, INC. cannot control the environment or usage of these components and therefore the customer is solely responsible for any cost of labor or material in conjunction with their maintenance and/or replacement.

To obtain this warranty service, the original purchaser must:

(1) Notify AVCOM OF VA, INC. if a possible defect is discovered, with the following information:
 (a) The model number and serial number.
 (b) A detailed description of the problem, including details of electrical connections to associated equipment and list such equipment.
(2) Obtain a verbal authorization from AVCOM OF VA, INC. in order to return the spectrum analyzer for warranty repair.
(3) Deliver the spectrum analyzer to AVCOM OF VA, INC. or ship the same in its original container or equivalent, fully insured and shipping charges prepaid.

Correct maintenance, repair, and use, are important to obtain proper performance from this product. Therefore, carefully read instructions provided. This warranty does not apply to any defect that AVCOM OF VA, INC. determines is due to:

(1) Improper maintenance or repair by unauthorized personnel, including the removal of factory seals or rivets, or the installation of parts or accessories that do not conform to the quality and specifications of the original parts.
(2) Misuse, abuse, lightning, alteration, neglect, or improper installation.

All implied warranties, if any, terminate one hundred eighty days from the date of the original purchase.

The above constitutes AVCOM OF VA, INC.'s entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation and exclusion may not apply to you.

This warranty gives specific legal rights and you may also have other rights which vary from state to state.

Manufacturer reserves the right to change specifications or design of this product without notice.

SASAR©
Form #1425 Rev B
Spectrum Analyzer System Analysis Report

Customer Name: _____ Date: _____

Address: City: _____

State: _____ Zip: _____ Phone: _____

System Description

Antenna: mfr _____ size _____ type _____

Polarization/feed: mfr _____ type _____

LNA/LNB (specify): mfr _____ max noise temp _____

gain ____ dB @ 3.7 GHz; gain ____ dB @ 3.9 GHz; gain ____ dB @ 4.2 GHz;

LNB output frequency _____ to _____ MHz

Pigtail: mfr _____ type (RG213/214) _____ length _____

Downconverter: mfr _____ output frequency _____

gain _____ max noise temp _____ inverted _____

Coax (from D/C to receiver): length _____ type _____

Receiver (primary): mfr _____ model _____

serial # _____ house location _____

Receiver (secondary) mfr _____ model _____

serial # _____ house location _____

System Performance Statistical Data

Satellite used: _____

Polarization/feed - cross polarization levels:

Vertical primary _____ dBm/max; Horiz _____ dBm/max

Horizontal primary _____ dBm max; Vert _____ dBm/max

Output levels:

LNA: ____ dBm @ 3.7 GHz; _____ dBm @ 3.9 GHz; _____ dBm @ 4.2 GHz

LNB: ____ dBm @ __ MHz; _____ dBm @ __ MHz; _____ dBm @ __ MHz;

D/C: ____ dBm @ __ MHz; _____ dBm @ __ MHz; _____ dBm @ __ MHz;

Coax: ____ dBm @ __ MHz; _____ dBm @ __ MHz; _____ dBm @ __ MHz;

Notes: _____

AVCOM
OF VIRGINIA INCORPORATED 500 SOUTHLAKE BOULEVARD, RICHMOND, VIRGINIA 23236 TELEPHONE (804) 794-2500

APPLICATION and SUGGESTION FORM

NAME _____

ADDRESS _____

PHONE _____

SPECTRUM ANALYZER: MODEL _____ SERIAL NUMBER _____

COMMENTS:

MAIL TO:

AVCOM
OF VIRGINIA INCORPORATED
500 SOUTHLAKE BOULEVARD
RICHMOND, VIRGINIA 23236
TELEPHONE (804) 794-2500

A self addressed envelope is enclosed for your convenience.

C-Band LNB Conversion Chart

Transponder	Freq. In MHz	Freq. Out MHz
1	3720	1430
2	3740	1410
3	3760	1390
4	3780	1370
5	3800	1350
6	3820	1330
7	3840	1310
8	3860	1290
9	3880	1270
10	3900	1250
11	3920	1230
12	3940	1210
13	3960	1190
14	3980	1170
15	4000	1150
16	4020	1130
17	4040	1110
18	4060	1090
19	4080	1070
20	4100	1050
21	4120	1030
22	4140	1010
23	4160	990
24	4180	970

LO-In=Out
LO-Out=In
LO=5150 MHz

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dBm to dBmv CONVERSIONS

dBm	POWER	50 ohms VOLTS	50 ohms dBmv	75 ohms VOLTS	75 ohms dBmv
-90	1.00 pW	7.07 uV	-43.01	8.66 uV	-41.25
-89	1.26 pW	7.93 uV	-42.01	9.72 uV	-40.25
-88	1.58 pW	8.90 uV	-41.01	10.90 uV	-39.25
-87	1.99 pW	9.99 uV	-40.01	12.23 uV	-38.25
-86	2.51 pW	11.21 uV	-39.01	13.72 uV	-37.25
-85	3.16 pW	12.57 uV	-38.01	15.40 uV	-36.25
-84	3.98 pW	14.11 uV	-37.01	17.28 uV	-35.25
-83	5.01 pW	15.83 uV	-36.01	19.39 uV	-34.25
-82	6.31 pW	17.76 uV	-35.01	21.75 uV	-33.25
-81	7.94 pW	19.93 uV	-34.01	24.41 uV	-32.25
-80	10.00 pW	22.36 uV	-33.01	27.39 uV	-31.25
-79	12.59 pW	25.09 uV	-32.01	30.73 uV	-30.25
-78	15.85 pW	28.15 uV	-31.01	34.48 uV	-29.25
-77	19.95 pW	31.59 uV	-30.01	38.68 uV	-28.25
-76	25.12 pW	35.44 uV	-29.01	43.40 uV	-27.25
-75	31.62 pW	39.76 uV	-28.01	48.70 uV	-26.25
-74	39.81 pW	44.62 uV	-27.01	54.64 uV	-25.25
-73	50.12 pW	50.06 uV	-26.01	61.31 uV	-24.25
-72	63.09 pW	56.17 uV	-25.01	68.79 uV	-23.25
-71	79.43 pW	63.02 uV	-24.01	77.18 uV	-22.25
-70	100.00 pW	70.71 uV	-23.01	86.60 uV	-21.25
-69	125.89 pW	79.34 uV	-22.01	97.17 uV	-20.25
-68	158.49 pW	89.02 uV	-21.01	109.03 uV	-19.25
-67	199.53 pW	99.88 uV	-20.01	122.33 uV	-18.25
-66	251.19 pW	112.07 uV	-19.01	137.25 uV	-17.25
-65	316.23 pW	125.74 uV	-18.01	154.00 uV	-16.25
-64	398.10 pW	141.09 uV	-17.01	172.79 uV	-15.25
-63	501.19 pW	158.30 uV	-16.01	193.88 uV	-14.25
-62	630.96 pW	177.62 uV	-15.01	217.53 uV	-13.25
-61	794.33 pW	199.29 uV	-14.01	244.08 uV	-12.25
-60	1.00 nW	223.61 uV	-13.01	273.86 uV	-11.25
-59	1.26 nW	250.89 uV	-12.01	307.28 uV	-10.25
-58	1.58 nW	281.50 uV	-11.01	344.77 uV	- 9.25
-57	1.99 nW	315.85 uV	-10.01	386.84 uV	- 8.25
-56	2.51 nW	354.39 uV	-9.01	434.04 uV	- 7.25
-55	3.16 nW	397.64 uV	-8.01	487.00 uV	- 6.25
-54	3.98 nW	446.15 uV	-7.01	546.42 uV	- 5.25
-53	5.01 nW	500.59 uV	-6.01	613.10 uV	- 4.25
-52	6.31 nW	561.68 uV	-5.01	687.91 uV	- 3.25
-51	7.94 nW	630.21 uV	-4.01	771.84 uV	- 2.25

dBm = Decibels Referenced from 1 milliwatt
dBmv = Decibels Referenced from 1 millivolt
0 dBm = 1 milliwatt
0 dBmv = 1 millivolt

SPECTRUM ANALYZERS, MICROWAVE SIGNAL GENERATORS, PORTABLE TEST RECEIVERS, SATELLITE RECEIVERS
CALL US WITH YOUR REQUIREMENTS.
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dBm to dBmv CONVERSIONS

dBm	POWER	50 ohms VOLTS	50 ohms dBmv	75 ohms VOLTS	75 ohms dBmv
-50	10.00 nW	707.11 uV	-3.01	866.02 uV	- 1.25
-49	12.59 nW	793.39 uV	-2.01	971.70 uV	- 0.25
-48	15.85 nW	890.19 uV	-1.01	1.09 mV	.75
-47	19.95 nW	998.82 uV	-0.01	1.22 mV	1.75
-46	25.12 nW	1.12 mV	.99	1.37 mV	2.75
-45	31.62 nW	1.26 mV	1.99	1.54 mV	3.75
-44	39.81 nW	1.41 mV	2.99	1.73 mV	4.75
-43	50.12 nW	1.58 mV	3.99	1.94 mV	5.75
-42	63.10 nW	1.78 mV	4.99	2.17 mV	6.75
-41	79.43 nW	1.99 mV	5.99	2.44 mV	7.75
-40	100.00 nW	2.24 mV	6.99	2.74 mV	8.75
-39	125.89 nW	2.51 mV	7.99	3.07 mV	9.75
-38	158.49 nW	2.82 mV	8.99	3.45 mV	10.75
-37	199.53 nW	3.16 mV	9.99	3.87 mV	11.75
-36	251.19 nW	3.54 mV	10.99	4.34 mV	12.75
-35	316.23 nW	3.98 mV	11.99	4.87 mV	13.75
-34	398.11 nW	4.46 mV	12.99	5.46 mV	14.75
-33	501.19 nW	5.01 mV	13.99	6.13 mV	15.75
-32	630.96 nW	5.62 mV	14.99	6.88 mV	16.75
-31	794.33 nW	6.30 mV	15.99	7.72 mV	17.75
-30	1.00 uW	7.07 mV	16.99	8.66 mV	18.75
-29	1.26 uW	7.93 mV	17.99	9.72 mV	19.75
-28	1.58 uW	8.90 mV	18.99	10.90 mV	20.75
-27	2.00 uW	9.99 mV	19.99	12.23 mV	21.75
-26	2.51 uW	11.21 mV	20.99	13.72 mV	22.75
-25	3.16 uW	12.57 mV	21.99	15.40 mV	23.75
-24	3.98 uW	14.11 mV	22.99	17.28 mV	24.75
-23	5.01 uW	15.83 mV	23.99	19.39 mV	25.75
-22	6.31 uW	17.76 mV	24.99	21.75 mV	26.75
-21	7.94 uW	19.93 mV	25.99	24.41 mV	27.75
-20	10.00 uW	22.36 mV	26.99	27.39 mV	28.75
-19	12.59 uW	25.09 mV	27.99	30.73 mV	29.75
-18	15.85 uW	28.15 mV	28.99	34.48 mV	30.75
-17	19.95 uW	31.59 mV	29.99	38.68 mV	31.75
-16	25.12 uW	35.44 mV	30.99	43.40 mV	32.75
-15	31.62 uW	39.76 mV	31.99	48.70 mV	33.75
-14	39.81 uW	44.62 mV	32.99	54.64 mV	34.75
-13	50.12 uW	50.06 mV	33.99	61.31 mV	35.75
-12	63.10 uW	56.17 mV	34.99	68.79 mV	36.75
-11	79.43 uW	63.02 mV	35.99	77.18 mV	37.75

dBm = Decibels Referenced from 1 milliwatt
dBmv = Decibels Referenced from 1 millivolt
0 dBm = 1 milliwatt
0 dBmv = 1 millivolt

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OF VIRGINIA INCORPORATED 500 SOUTHLAKE BOULEVARD, RICHMOND, VIRGINIA 23236

dBm to dBmv CONVERSIONS

dBm	POWER	50 ohms VOLTS	50 ohms dBmv	75 ohms VOLTS	75 ohms dBmv
-10	100.00 uW	70.71 mV	36.99	86.60 mV	38.75
- 9	125.89 uW	79.34 mV	37.99	97.17 mV	39.75
- 8	158.49 uW	89.02 mV	38.99	109.03 mV	40.75
- 7	199.53 uW	99.88 mV	39.99	122.33 mV	41.75
- 6	251.19 uW	112.07 mV	40.99	137.25 mV	42.75
- 5	316.23 uW	125.74 mV	41.99	154.00 mV	43.75
- 4	398.11 uW	141.09 mV	42.99	172.79 mV	44.75
- 3	501.19 uW	158.30 mV	43.99	193.88 mV	45.75
- 2	630.96 uW	177.62 mV	44.99	217.53 mV	46.75
- 1	794.33 uW	199.29 mV	45.99	244.08 mV	47.75
0	1.00 mW	223.61 mV	46.99	273.86 mV	48.75
1	1.26 mW	250.89 mV	47.99	307.28 mV	49.75
2	1.58 mW	281.50 mV	48.99	344.77 mV	50.75
3	2.00 mW	315.85 mV	49.99	386.84 mV	51.75
4	2.51 mW	354.39 mV	50.99	434.04 mV	52.75
5	3.16 mW	397.64 mV	51.99	487.00 mV	53.75
6	3.98 mW	446.15 mV	52.99	546.42 mV	54.75
7	5.01 mW	500.59 mV	53.99	613.10 mV	55.75
8	6.31 mW	561.68 mV	54.99	687.91 mV	56.75
9	7.94 mW	630.21 mV	55.99	771.85 mV	57.75
10	10.00 mW	707.11 mV	56.99	866.02 mV	58.75
11	12.59 mW	793.39 mV	57.99	971.70 mV	59.75
12	15.85 mW	890.19 mV	58.99	1.09 V	60.75
13	19.95 mW	998.82 mV	59.99	1.22 V	61.75
14	25.12 mW	1.12 V	60.99	1.37 V	62.75
15	31.62 mW	1.26 V	61.99	1.54 V	63.75

The decibel (dB) is a dimensionless number that expresses the ratio of two power levels. It is defined as

$$dB \equiv 10 \log_{10}\left(\frac{P_2}{P_1}\right)$$

When voltages are measured across the same or equal resistors the number of dB is given by

$$dB \equiv 20 \log_{10}\left(\frac{V_2}{V_1}\right)$$

Prefixes.

Prefix	*Factor*	*Symbol*
tera	10^{12}	T
giga	10^{9}	G
mega	10^{6}	M
kilo	10^{3}	K
hecto	10^{2}	h
deka	10	da
deci	10^{-1}	d
centi	10^{-2}	c
milli	10^{-3}	m
micro	10^{-6}	μ
nano	10^{-9}	n
pico	10^{-12}	p
femto	10^{-15}	f
atto	10^{-18}	a

MKS Units.

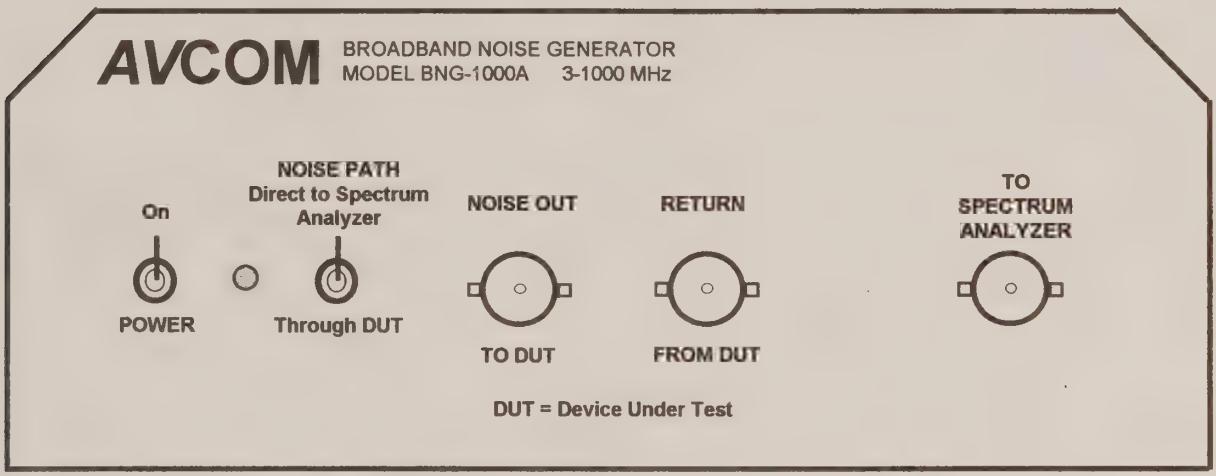
Quantity	*Unit*	*Symbol*
Capacitance	farad = coulomb per volt	F
Charge	coulomb: $A - s$	Q
Conductance	mhos	$\mho$
Current	ampere = coulomb per second	A
Cycles	hertz per second	Hz
Energy	joule	J
Field	volt per meter	E
Flux linkage	weber = volt-second	Ψ
Inductance	henry = $\frac{V - s}{A}$	H
Micron	10^{-6} m	μm
Power	watt = joule per second	W
Resistance	ohm	Ω
Voltage	volt	V

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NEW!!! from AVCOM

BNG-1000A

BROADBAND NOISE GENERATOR

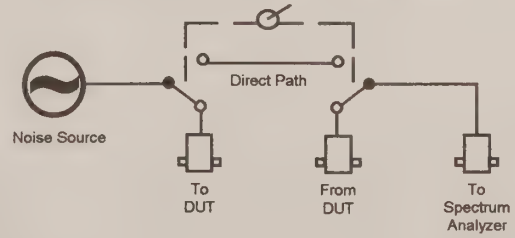


BNG-1000A $ 475.00

Increase the capability of your spectrum analyzer with this versatile accessory

The BNG-1000A Broadband Noise Generator adds to the capability of spectrum analyzers such as AVCOM's PSA-65A by allowing them to perform frequency response measurements similar to the use of a tracking generator. The BNG-1000A noise source is useful for sweeping co-axial cables, tuning filters and characterizing amplifiers. Intergral RF switching allows the noise reference level to be displayed on the spectrum analyzer, and by a front panel switch, the device under test (DUT) is placed into the network and its response immediately observed. Insertion loss can be measured with the flip of a switch.

BNG-1000B Block Diagram



SPECIFICATIONS

Frequency Range
3-1000 MHz
Output Level
Using AVCOM's PSA-65A Portable Spectrum Analyzer
-30 dBm with span set 100 MHz/Div and 3 MHz Res. B.W.
Flatness
± 3 dB typical
Power Requirements
+12 to +24 VDC @ 200mA
115 VAC to +12 VDC adapter provided
Powered by the AUX. jack on the PSA-65A
Powered by the LNA/BDC power switch on the PSA-35A and PSA-37D (optional)
Dimensions
6.5"W x 2.25"H x 7.25"D
16.5cmW x 5.7cmH x 18.4cmD
Weight
2lbs./.9kg

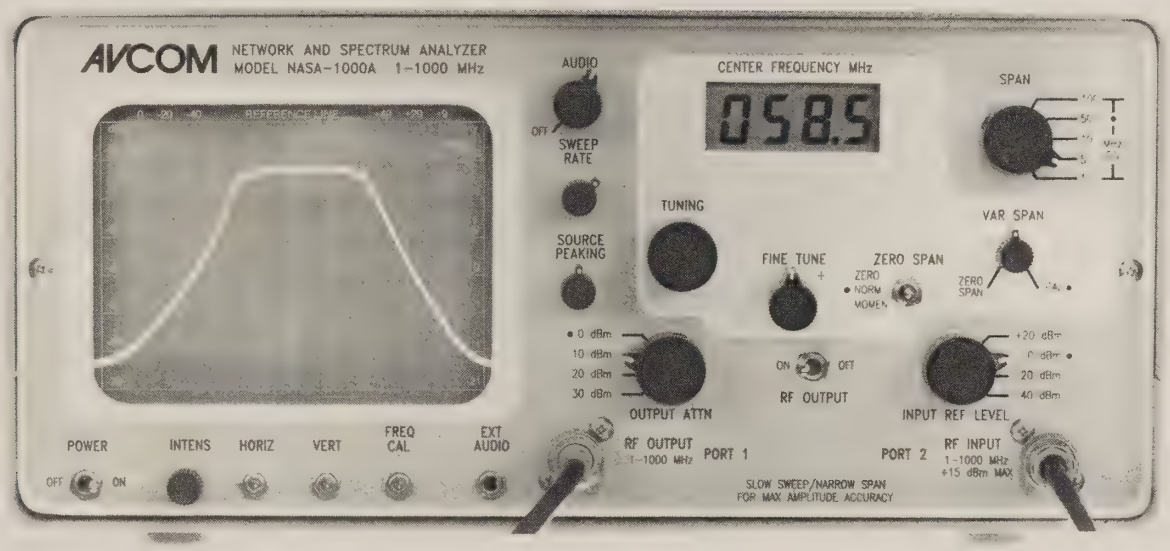
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NEW !!! from AVCOM

NSA-1000A

Network And Spectrum Analyzer



NSA-1000A $3875

Enhance your capabilities with the powerful performance of this revolutionary instrument.

The NSA-1000A is a powerful and versatile Integrated Network And Spectrum Analyzer. It can be used as a stand alone 1-1000 MHz spectrum analyzer with an internal FM demodulator or used as a network analyzer by activating its built in tracking generator.

Description

The NSA-1000A's front panel is functionally separated into 3 areas; the display, an RF source and a swept receiver (spectrum analyzer). The frequencies of the RF source and of the swept receiver track and the response of an RF network inserted between the RF source and receiver is displayed on a CRT. Step attenuators in the source and receiver facilitate measurement of lossy networks (i.e. filters, attenuators) and networks with gain (i.e. amplifiers).

Network Analyzer

The NSA-1000A used as a network analyzer allows the operator to make swept measurements of filters, duplexers and amplifiers from 1 to 1000 MHz with a dynamic range of > 90 dB. Stimulus-response measurements of other RF networks can be made. The NSA-1000A's flexibility is increased by a built in attenuation/reference level system. The light-weight NSA-1000A is the ideal instrument for testing of RF communication systems, classroom instruction, cable TV maintenance and production use.

Spectrum Analyzer

The NSA-1000A also functions as a versatile, and cost effective stand alone spectrum analyzer with a frequency range of 1 to 1000 MHz and a sensitivity of -95 dBm. The NSA-1000A is ideal for receiver and transmitter alignment and troubleshooting, LAN analysis, cable head end level balancing, and satellite receiver alignment and signal demodulation (with optional demodulator). Other applications include classroom instruction, production testing, cable TV maintenance, amateur radio, and surveillance and countermeasures. Options include FM demodulator, AM detector, DC power inserter and LPA-1000 log periodic antenna.

NSA-1000A Network And Spectrum Analyzer Technical Specifications

NETWORK ANALYZER

SOURCE - PORT 1

FREQUENCY COVERAGE
1 MHz to 1000 MHz in one sweep.
OUTPUT ATTENUATION LEVELS
0, -10, -20, -30 dBm
OUTPUT CONNECTOR
Type BNC Standard - F,SMA and N adapters available
AMPLITUDE ACCURACY
+ 2 dB typical
FLATNESS
< 4 dB P-P
IMPEDANCE
50Ω

RECEIVER - PORT 2

FREQUENCY RANGE
1 MHz to 1000 MHz in one sweep.
MAXIMUM INPUT LEVEL
+15 dBm
RESOLUTION BANDWIDTH
150 KHz Fixed
INPUT REFERENCE LEVELS
+20, 0, -20, -40 dBm
INPUT CONNECTOR
Type BNC Standard - F,SMA and N adapters available
IMPEDANCE
50Ω, 75Ω adapters available
CROSSTALK
< 92 dB over 90% of the bandwidth - typ.

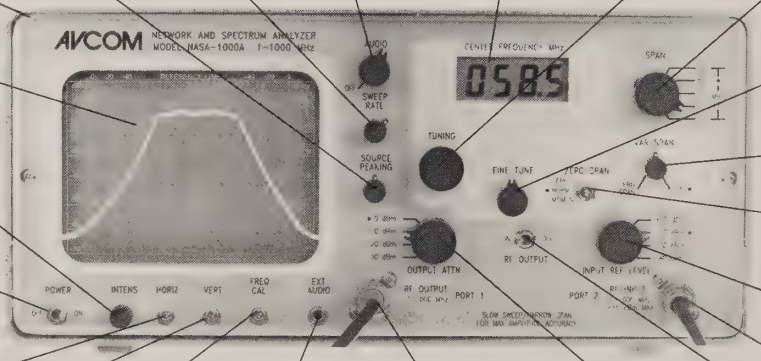
SPECTRUM ANALYZER - PORT 2

FREQUENCY COVERAGE
1 MHz to 1000 MHz in one sweep.
SENSITIVITY
-95 dBm typical
AMPLITUDE ACCURACY
+ 2 dB typical
RESOLUTION BANDWIDTH
150 KHz Fixed
REFERENCE LEVELS
+20, 0, -20, -40 dBm
INPUT CONNECTOR
Type BNC Standard - F,SMA and N adapters available

OPTIONS
FM Demodulator
AM Audio Detector
ACCESSORIES
DCP-20 DC Power Inserter
LPA-1000 Log Periodic Antenna

PHYSICAL CHARACTERISTICS

FREQUENCY DISPLAY
4 digit LCD Frequency Readout
100 KHz resolution
CRT DISPLAY
10 horizontal graticule Divisions(frequency) x 7 vertical graticule Divisions (amplitude). Each vertical Division equals 10 dB.
DIMENSIONS
11.5"W x 5.5"H x 15.5"D
(290 x 125 x 385 mm)
WEIGHT
18 Lbs / 8.18 Kg
POWER REQUIREMENTS
External 115 VAC / 60 Hz
220/240 VAC / 50 Hz models available



SOURCE PEAKING Synchronizes the swept receiver to the source in the network analyzer mode.

SWEEP RATE controls the speed of the sweep across the CRT.

AUDIO activates audio demod board and sets audio level.

CENTER FREQUENCY is a 4 digit LCD display that allows you to accurately read center frequency of the PSA-65A display in tenths of a MHz.

TUNING adjusts the center frequency of the analyzer so that signals of interest appear on the center of the display and their frequency is read out on the LCD.

SPAN controls the width of the spectrum being displayed.

Attractively styled package and ergonometrically engineered front panel for an instrument that is a pleasure to own and use.

Large bright screen for outdoor and indoor use. Scale calibrated in 10 dB steps for accurate repeatable measurements. 60 dB dynamic range.

FINE TUNE allows fine changes in center frequency. Greater adjustment range on left knob settings, finer adjustment on right knob settings.

VAR SPAN reduces the width of the spectrum being displayed for closer signal examination and enhanced amplitude accuracy.

INTENSITY controls the brightness of the display.

ZERO SPAN instantly places analyzer in zero span mode and activates audio demodulator for convenient monitoring.

POWER switch has 2 positions, ON and OFF. An amber LED is illuminated when POWER is ON.

INPUT REFERENCE LEVEL adjusts input attenuator and IF gain so that top graticule corresponds to indicated signal level. Calibrations in dBm are provided.

RF INPUT - PORT 2 - accepts signals to be observed from less than 2 MHz to greater than 1000 MHz.

HORIZ is used to position the display on the screen laterally.

VERT is used to position the display on the screen.

FREQ CAL adjusts frequency displayed on LCD.

EXT AUDIO drives low impedance earphones or speaker. Internal speaker provided with optional demod.

RF OUTPUT - PORT 1 1-1000 MHz source for synchronized receiver.

OUTPUT ATT 30 dB step attenuator for RF OUTPUT.

RF OUTPUT activates and deactivates output at source - PORT 1.

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Private Cable

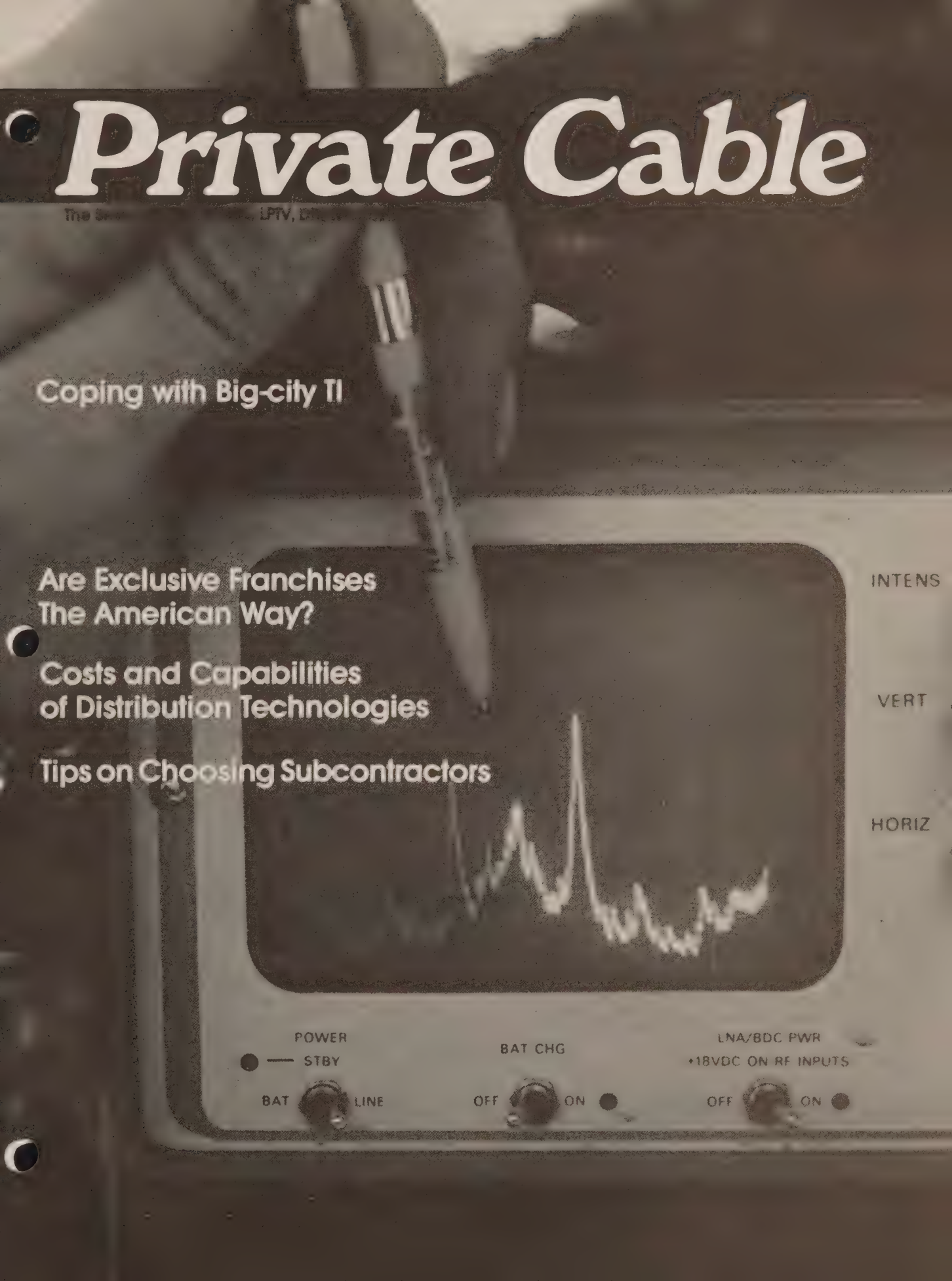
The Se... LPTV, DBS...

Coping with Big-city TI

Are Exclusive Franchises The American Way?

Costs and Capabilities of Distribution Technologies

Tips on Choosing Subcontractors



Coping with Big-City TI

By Tom H. Thompson
Prime Focus Communications

Chicago's role as a major center for transportation, manufacturing and commerce has made the city a natural hub for microwave telephone communications, television network feeds and data transmission.

Repeater horns sprout from such landmarks as the John Hancock Building, Sears Tower and the AT&T Building and at least a dozen other buildings.

Terrestrial interference (TI) maps and frequency coordination are of limited value in a TI environment of this density. An average site survey conducted at an elevation of 30 stories or more along Michigan Avenue will reveal all 25 of the 3710- to 4190-MHz (horizontal polarity) frequencies allocated for point-to-point microwave transmissions in levels ranging from destructive (complete wipeout of satellite carrier) to minimal (slight tearing and busy picture).

The number of repeaters and C-band frequencies in use is compounded by diffraction, knife-edge effect and reflection of the interfering carriers from the point of transmission. Buildings can be excellent reflective surfaces for microwaves. An interfering carrier source may transmit in a direction 90 degrees from a site location and the signal can still be reflected into the satellite antenna from several buildings in the interfering repeater's line of sight.

Coping

The private cable contractor and operator should determine the answers to several questions before seriously considering any private cable system installation:

- What is the TI carrier amplitude?
- What is the nature of the interference (broadband, telephone carrier, etc.)?
- What is the carrier frequency?
- What are the elevation and azimuth of the TI source?
- Can it be avoided or suppressed?
- Will the installation still be profitable?

TI Site Surveys

A site survey provides the private cable contractor or operator with the proper information to estimate the proposed system cost. A good survey should reveal the most inexpensive and effective means for handling terrestrial interference. A survey also might reveal the proposed installation will not be profitable because expensive TI countermeasures will drive it over budget.

The TI site survey can be broken down into three steps:

(1) Pre-site survey: Information and data affecting the proposed site is collected and analyzed. The on-site survey equipment and methods are selected and the on-site survey is scheduled.

(2) On-site survey: Data at the proposed installation site is collected through spectrum analysis, frequency tracing, detailed line-of-sight tests and other methods.

(3) Post-site survey: Data and relevant information collected during the pre- and on-site surveys is compiled and evaluated, then written as a report to enable precise decision making. A follow-up site survey may be performed if original data is inconclusive.

Pre-site Survey

TI survey maps and frequency coordination charts, which can be invaluable

After turn-on, terrestrial interference countermeasures can be costly and sometimes ineffective. Author outlines practical methods and equipment for living with TI in an urban environment.

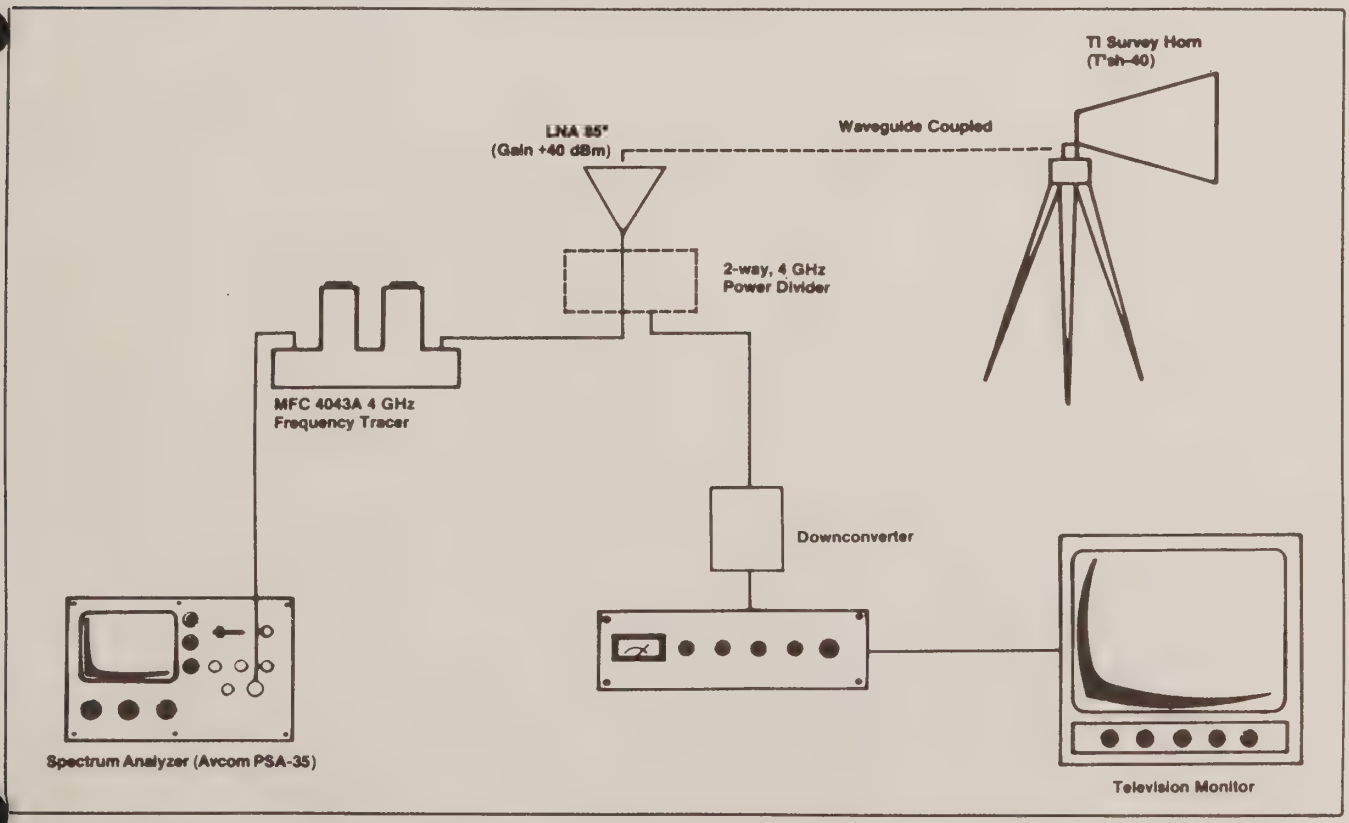


Fig. 1—Essential test equipment to identify carrier frequencies and bandwidth includes a spectrum analyzer and frequency tracer.

in suburban or rural locations, are difficult to apply in the saturation of the 4-GHz band downtown. Levels and frequencies vary from block to block and rooftop to rooftop. Site elevation and building reflections are more often determining factors than the locations of individual repeaters. Frequency coordination services and in-house surveys on file for a particular area give an indication of what to expect, but it is next to impossible to accurately estimate cost from those sources alone.

Using the services of a frequency coordination firm, however, is a good investment for any private cable system that has 4-GHz satellite programming. Frequency coordination services not only provide the locations and frequencies of existing 4-GHz repeaters, the service also keeps the private cable operator informed of proposed 4-GHz repeater sites that may create interference in the future.

Most frequency coordination services also provide assistance in obtaining an FCC license for the proposed private cable installation. An FCC license is additional insurance for the continued reception quality of the earth station.

The simplest things are sometimes overlooked during the pre-site survey. Contacting the building management and maintenance people to coordinate access and an escort for the on-site survey is an example. Making arrangements for review of building plans and discussing the project with the building's architectural firm help decide the antenna size and location.

Virtually all private cable installations around Chicago's city center are roof mounts on tall buildings. It is normally required that the proposed antenna size, location and method of mounting be approved for windloading and structural integrity by an architect before a contract can be approved. Since antenna selection and placement is a critical factor in the avoidance of terrestrial interference, it is a good idea to have criteria that dictates these decisions.

Scheduling the on-site survey is another important consideration. The peak loads of telephone carriers normally occur on weekdays between 1 p.m. and 5 p.m. As the load (number of telephone calls handled on a given microwave carrier frequency) increases, the amplitude and bandwidth of the interfering carrier will increase, causing further degradation on the adjacent C-band satellite transponders.

The heaviest times for telephone communications are Friday afternoons at the beginning and ending of the month. (Sales quotas? Heavy trading?) It is advisable to schedule the on-site survey during those times to predict accurately the highest levels of terrestrial interference the private cable system will endure.

Survey Equipment

One school of thought says that the only way to conduct a TI site survey is with a portable satellite antenna, satellite receiver and a TV monitor. This is a good approach, but it can result in misleading conclusions and an ineffective survey. A collapsible or a small antenna simply will not have the gain, beamwidth, noise temperature, or sidelobe rejection of a commercial-grade antenna. (The *ASTI Manual*, published by Microwave Filter Co., has a complete explanation of the criteria for antenna selection for TI environments.)

An interfering carrier level, received as complete picture wipeout (uniform or gray screen) through a portable antenna, may be received through a commercial cassegrain antenna as strobing, horizontal noise bars that can be filtered at a nominal cost. A profitable private cable project could be abandoned if another method of determining terrestrial interference levels is not applied.

Prime Focus Communications (PFC) technicians have found the portable spectrum analyzer to be the most effective item of equipment for the identification and analysis of terrestrial interference. Portable and mobile C-band antennas are used when feasible. Survey site accessability and time limitations usually make the spectrum analyzer equipped with survey horn, LNA and terrestrial interference frequency tracer the best equipment for an initial site survey. If the initial site survey proves positive, the additional expense of confirming the results with a portable antenna can be justified.

The Avcom PSA-35 portable spectrum analyzer has a convenient carrying case, a rechargeable internal battery, is relatively insensitive to shock or temperature variances and costs approximately $2,000. It can be used for headend system troubleshooting, setting aural and video levels, distribution system sweep tests and adjusting for tilt and slope.

The cost of the initial site survey equipment is approximately $4,500. Losses resulting from one "uninstall" due to unacceptable levels of terrestrial interference would easily offset this expense. The equipment for conducting on-site surveys with satellite antennas could easily be more than $6,500 if purchased outright. Normally, satellite installation and private cable companies have this type of equipment on hand for mobile downlinks or demonstrations.

On-site Survey

Once the pre-site survey has been accomplished, the "real" survey can begin. The on-site survey team normally consists of a field engineer and an experienced installation technician. Upon arrival at the site the team should contact the building engineer or maintenance person as previously arranged. The building engineer can provide a wealth of information on the building's construction and electrical wiring. The engineer usually has a definite idea of the antenna location. The site will invariably have a building 10 stories taller in direct line of sight south, or will be looking down the throat of a 4-GHz AT&T feed across the street. Occasionally, the primary mission of the on-site survey team is collecting enough hard data to convince the building management that an alternative site is necessary.

One of the initial tasks for the on-site survey team is confirming an adequate "window" to the desired satellite(s). A compass, inclinometer, detailed street map and modified camera tripod are the minimum equipment required for a line-of-sight survey. As HVAC units and

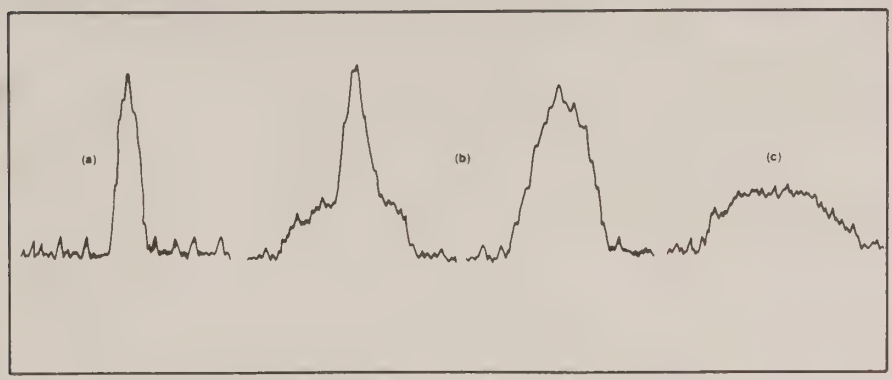


Fig. 2—Interfering carriers have distinctive signatures on a spectrum analyzer. FM telephone carriers (a), wideband television or digital telephone and data carriers (b) and broadband "spread spectrum" carriers are all common.

other roof-mounted metal structures are not conducive to accurate compass readings, referencing true azimuth to a map is imperative. Look angles can be tight, with little margin for error. Fortunately, many Chicago city streets run grid north-south and east-west.

After identifying potential antenna sites, a quick check should be conducted with the spectrum analyzer to assess general TI levels. A TI survey horn, LNA and RG-213 jumper are used in conjunction with the analyzer to accomplish this. The spectrum analyzer is set to a zero dB reference and bandwidth (MHz per division) set to maximum for display of the entire 500-MHz band at 3.7 to 4.2 GHz.

Of particular interest at this phase is the location of shielding provided by existing structures (such as elevator shaft head housings) and fixing the direction of strong TI sources. A spotting scope can be useful for locating line-of-sight repeaters. Frequency coordination charts and route maps will also be useful for pinpointing the location of TI sources.

Avcom's Tish-40 survey horn is reasonably directional, which makes this task easier than it might seem. "Hot-spots" and antenna sites with unfavorable levels of wideband TI carriers can be promptly eliminated from detailed surveys. Two or three potential sites may be selected for detailed analysis if sufficient "windows" and TI levels permit. Wind-loading, structural considerations and the aesthetic preferences of building management will also be a consideration in the selection process. Selected sites may then be drawn to scale on the "site map" prepared on location. The location and direction of TI sources will be noted on the map.

Detailed Frequency Survey

After deciding on the potential antenna sites, it is necessary to perform a detailed frequency analysis of TI carriers at each site. A stable platform with elevation and azimuth adjustments and mounting provisions for the survey horn is necessary to maintain continuity of sample reference levels. A camera tripod may be modified for this purpose.

When setting up the survey horn and tripod, it is important to note the dimensions of any structures that provide shielding. The survey horn should be positioned at the approximate focal center of the antenna to be installed. The tripod can be lashed to a step ladder if necessary. If the antenna on its mount, at the appropriate look angle, will be 13 feet high, and the shielding structure is 10 feet high, the survey horn should be positioned accordingly.

A quick sample should be taken at the antenna's highest point of exposure. Additional screening may be required.

Final Measurements

After the survey horn has been set at the proposed antenna site, its focal phase center is aligned to the elevation and azimuth (horizontal polarity) of the satellite selected for programming services. The test equipment is connected and the spectrum analyzer calibrated (see Fig. 1). An MFC 4043A TI frequency tracer (a component of the MFC Sky Doc kit) is placed in series with the LNA and spectrum analyzer to identify carrier frequencies and bandwidth. To compensate for diffraction and polarization conversion, the survey horn can be slightly skewed on its axis to obtain maximum amplitude on various carrier sets. Telecommunication carriers from a single repeater are normally arrayed in sets of six, with an 80-MHz spread between carriers on the same polarity. Far more carriers are in operation in the Chicago metropolitan area than there are frequencies allocated in the 3.7- to 4.2-GHz band.

'Familiarity with the various repeater site signatures comes with 20 to 30 surveys in the area.'

A carrier's amplitude level does not necessarily correspond to a single repeater source. Carrier amplitude on a given frequency is normally a composite signal of different reflections and the polarization conversion of an identical frequency on the opposite polarity. Familiarity with the various repeater site "signatures" comes with 20 to 30 surveys in the area.

If out-of-band interference is suspected, a 3.7- to 4.2-GHz bandpass filter can be inserted after the LNA. Due to antenna selectivity and the improvements in today's satellite electronics, out-of-band interference has been a problem in only one installation.

As each carrier is identified, the frequency, relative amplitude, bandwidth and carrier type are recorded for the survey report. Both polarities are checked and the survey horn is skewed to permit maximum amplitude samples.

The TI carriers most often exper-

ienced are telephone communication carriers. These carriers have distinctive signatures on the analyzer at 10 MHz per division (see Fig. 2a). The carrier will have an FM deviation of approximately 3 to 5 MHz and will come to a sharp peak. Most telephone carriers "pulsate" (deviate rapidly in amplitude and slightly in bandwidth), but this is not always apparent on the analyzer display. Unless the telephone carrier is strong (over +15 dBm) in relation to the satellite signal, notch filtering is normally adequate to restore satellite signal integrity.

Figure 2b is an example of a TV network audio. video wideband carrier. Although major network affiliates use satellite downlinks for newsfeeds, and network programming, the point-to-point relay tower system is still much in operation. As illustrated, the wideband audio/video carrier looks similar to a frequency modulated satellite transponder, with subcarrier information ±10 to 12 MHz, or more from center frequency.

Wideband digital telephone carriers and wideband data carriers are in a format similar to this. Wideband carriers cannot be filtered effectively without deteriorating the quality of the satellite signal. If a wideband TV carrier is transmitting at 3730 MHz on the horizontal polarity, and transponder 2 at 3740 MHz on the same polarity is desired for programming, the wideband carrier will be within the effective bandwidth of the satellite transponder. Screening, antenna selection and creative siting must lower the wideband subcarrier levels to the system noise floor before filtering, or expensive phase-cancellation techniques will be necessary. Fortunately, the carrier's sidebands will not make a polarization conversion except in extreme levels. One of the on-site survey team's responsibilities is to find a site least susceptible to wideband carriers, even if this site is exposed to telephone carriers. The telephone carriers are certainly the lesser of two evils in this case.

If the survey team wants to confirm a wideband network TV carrier, a two-way power divider/block can be inserted after the LNA, and a jumper run to a downconverter/receiver connected to a monitor (see Fig. 1). By inverting the receiver video format and tuning the receiver to the carrier's frequency, a picture—usually color bars with network ID and audio tone—will be on the monitor. The signal will be seen as pulsing noise or bars on screen if the wideband carrier is in a digital format.

'The telephone carriers are certainly the lessor of two evils in this case.'

Figure 2c is an example of recently experienced terrestrial interference that will be referred to as broadband or "spread spectrum." The carrier does not display a strong center carrier as do FM telephone or TV network carriers. The signal appears spread out over +20 MHz of bandwidth. Identifying the source and information on this carrier is difficult.

Post-site Survey

After collecting the on-site survey data, the data should be compiled and written as a report. The report will reflect information from the pre- and on-site surveys. Detailed site maps and drawings showing shielding structures, proposed antenna sites, mounting recommendations, potential screen locations and strong TI point sources will also be included with the report.

It is important to include all reference information in the site survey report. Listing the type of equipment used, equipment calibration settings and time-date-weather information is necessary if the report is to be reviewed by a second party. Another opinion is sometimes requested by the contractor before final decisions are made, and the project may warrant consultation with an outside engineering source for confirmation.

The polarity, frequency, relative amplitude, type and bandwidth of each TI carrier found during the detailed frequency survey will be listed in the report. The on-site field engineer will break the data down into an understandable form for the contractor or a non-technical person in a short synopsis. The surveying field engineer also notes any unusual circumstances and makes antenna siting, TI avoidance and suppression recommendations based on his findings. If a follow-up survey is recommended, or an outside consultant is requested, the field engineer will indicate so in his comments.

Armed with the information contained in the TI site survey report, the private cable contractor or operator can evaluate the proposed installation, and prepare a realistic contract proposal.

Experience Pays

Experience is a big factor in TI site surveys and TI countermeasures.

It is strongly recommended that consideration be given to obtaining initial site surveying equipment and TI surveys being performed before bidding on a PC contract.

Experienced independent consultants are available in most areas at a flat fee. Even experienced private cable contractors occasionally require assistance in borderline situations. A small initial investment in the proper equipment or consultation could prevent an unnecessary major loss.

Tom Thompson is a field engineering consultant for Prime Focus Communications. He has worked for Intersat, Uniden and Wavetek in positions ranging from service to quality control, and repair to technical sales support.

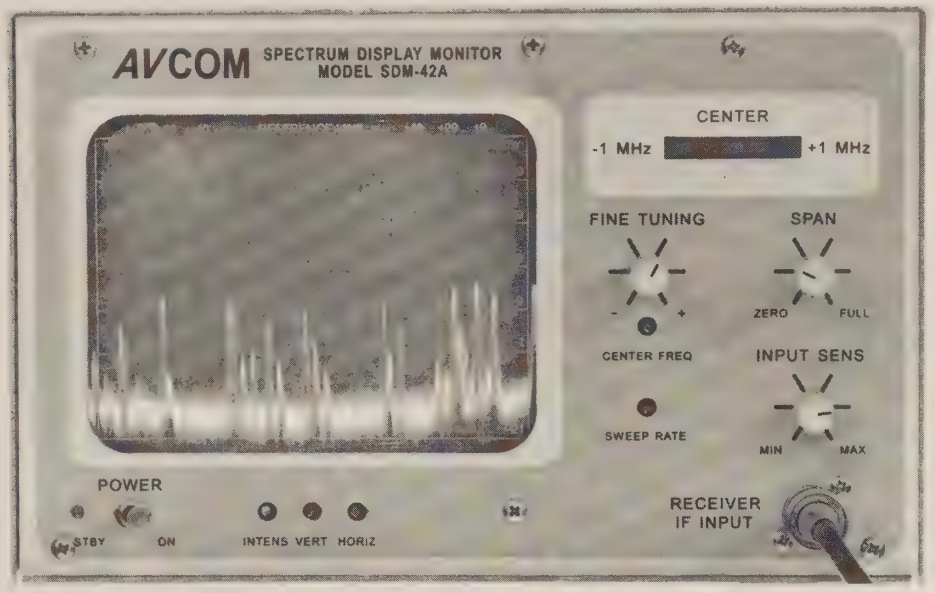
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NEW !!! from AVCOM

SDM-42A

SPECTRUM DISPLAY MONITOR



SDM-42A $1145

AVCOM's **SDM-42A Spectrum Display Monitor** is designed for use as a panoramic signal display for VHF scanners and communication receivers such as the ICOM R-7000. The **SDM-42A** displays all signals present in the receiver's IF on a 5" CRT so that the operator can monitor signal activity. The operator can then quickly tune to signals as they appear on the spectrum display. This greatly facilitates locating and tuning of intermittent signals as well as surveilling a particular frequency band. The **SDM-42A Spectrum Display Monitor** (with a scanner) can be used with AVCOM's **PSA-65A Portable Spectrum Analyzer** to create a powerful broad and narrow band spectrum monitoring system.

The **SDM-42A** spectrum display can be used for other applications such as monitoring satellite receiver IF's and demodulating single channel per carrier satellite signals (with optional demodulator circuitry). It can also be used as a general purpose spectrum analyzer covering specific frequency ranges.

The **SDM-42A** is available for receiver IF frequencies of 10.7, 21.4, 45 and 70 MHz, and other IF frequencies upon request.

SPECIFICATIONS

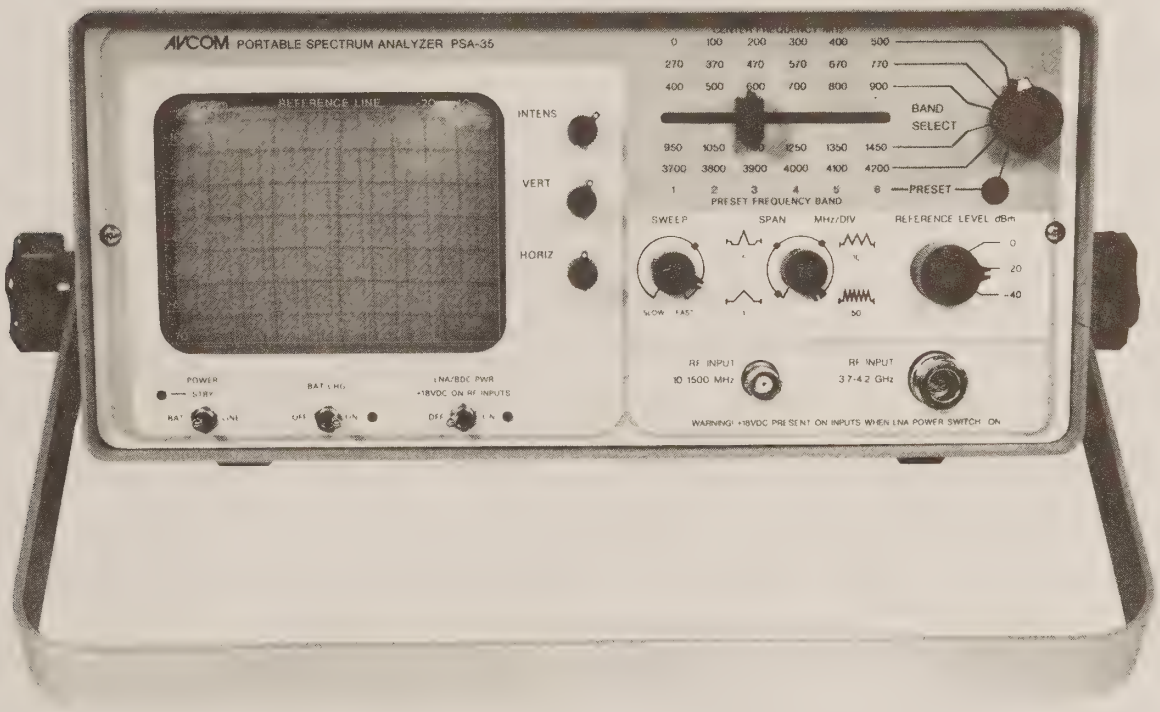
IF INPUT
Customer specified. Standard frequencies include 10.7, 21.4, 45 and 70 MHz
RESOLUTION BANDWIDTH
10 KHz Standard
DYNAMIC RANGE
65 dB
FREQUENCY DISPERSION (SPAN)
Variable from ± 5 MHz of center frequency to zero span
AMPLITUDE SENSITIVITY
10 dB/Div
POWER REQUIREMENTS
110 VAC/60 Hz (other voltages available upon request)
DIMENSIONS
8.25"(209mm) x 5.00"(127mm) x 11.00"(279mm)
WEIGHT
8.25 lbs (3.75 Kg)

AVCOM®
OF VIRGINIA INCORPORATED
500 SOUTHLAKE BOULEVARD
RICHMOND, VA 23236
TELEPHONE 804-794-2500
FAX 804-794-8284

Made in the U.S.A. Specifications subject to change without notice.

Avcom's Portable Analyzer Is An Important Diagnostic Tool

By Lee Bolen



THE MARKETING TECHNIQUES MAGAZINE FOR SATELLITE TV PROFESSIONALS

SATELLITE TV OPPORTUNITIES Magazine

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Avcom's Portable Analyzer Is An Important Diagnostic Tool

By Lee Bolen

Avcom produces a complete product line of satellite receivers, microwave instruments, components and spectrum analyzers. This article discusses a new product from Avcom, the PSA-35 Portable Spectrum Analyzer.

This battery operated instrument is a sweep frequency analyzer which measures rf signals in frequency ranges from 10 to 1500 MHz and 3.7 to 4.2 GHz. This instrument can be used for checking the signal strength from LNAs and downconverter systems, for determining the source and strength of terrestrial interference, for determining possible connector or cable loss at all frequencies of interest and for assuring the alignment and correct polarization of polaroter systems.

Its versatility makes it a valuable tool for the installer of TVRO receivers who wishes to optimize the performance of the system and to obtain quantitative measurements which can be used to document any degradation or change in the system after installation.

The spectrum analyzer appears much like a small oscilloscope with a CRT screen and frequency range adjustment knobs on the front panel. The display on the oscilloscope screen is a plot of the signal strength versus frequency for a span of frequencies which are chosen by the control knobs. Thus it is possible to measure the amplitude of each transponder accurately and to observe the characteristics of each element in the amplification and downconversion system in the complete TVRO installation.

Figure 1 shows an illustration of the signal received from the band of transponders in the G1 satellite with vertical polarization. The height of each spike is proportional to the signal strength of each individual transponder. Such a visual display provides an instantaneous interpretation of the signal quality and possible background interference which is being amplified.

Technical Description

All controls for operation of the instrument are contained on the front panel. They include the cathode ray screen for spectrum display with intensity controls and vertical and horizontal position controls much like a normal oscilloscope. The power control turns on the instrument and chooses either internal battery or line voltage power supply. A second adjacent switch connects the internal battery to a charging circuit.

The instrument can also provide 18 volts DC to each of the signal input connectors to power either a low noise amplifier or a block converter via the feed line. The third switch controls this DC power source.

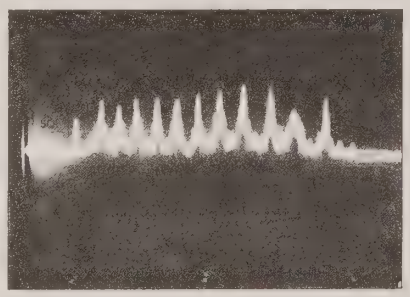


Fig. 1

The controls in the upper right corner select the frequency band to be displayed on the CRT screen. The sliding control knob determines the center frequency to be displayed on the center of the screen. The rotating knob to the right selects the frequency range of interest. Frequencies in the range from 10 to 1500 MHz and 3.7 to 4.2 GHz can be displayed.

Adjust Span Control

Once the band of frequencies and center frequency have been selected, it is necessary to adjust the span control directly below the center frequency knob. This controls the bandwidth of frequencies displayed on the screen. In essence it determines the starting frequency on the left of the sweep and the ending frequency at the right-hand side of the sweep. By adjusting this knob, it is possible to display only a portion of the frequency band in greater detail by spreading the frequencies out on the screen, or it is possible to display the entire frequency band starting at the left and continuing to the right of the screen.

The rate at which the frequency band is swept is determined by the sweep knob at the left of the span control. This determines the rate at which the heterodyning sweep takes place and permits sweep speeds fast enough to produce a flicker-free display that is easily viewed or photographed using an oscilloscope camera. The vertical amplitude adjustment, equivalent to the gain on an oscilloscope, is adjusted by the reference level control at the far right of the control knobs.

The display on the oscilloscope screen is logarithmic, with a readout in units of dBm. The reference level control at the right-hand side permits variations in the sensitivity of the display. In the 0 dBm position, a signal at the top of the display screen will have an amplitude of 0 dBm. Adjustments can be made to set the reference at the top of -20 or -40 dBm. In the -40 dBm position, signals as weak as -90 dBm can be observed at the bottom of the screen. This would be particularly useful when looking for terrestrial noise sources or other background noise which could provide interference to the signals being received.

Two types of inputs are located at the bottom right of the front panel. The first is an rf BNC connector to

accept signals in the 10 to 1500 MHz range. A type N connector accepts signals from 3.7 to 4.2 GHz for direct connection to the LNA. As mentioned previously, it is possible to insert an 18 volt DC signal to each of these connectors to power the appropriate amplifier systems.

On the underside of the chassis there is a horizontal display reversing switch which can be used in those special applications when the block converter reverses the input to output frequency relationship. Without this reversing switch, the display on the screen would display frequencies in reverse order, that is, from highest to lowest frequency. When needed, this switch will permit all displays to conform to the normal left to right increase in frequency.

In order to provide a report on the quality of performance of a satellite system, the operator's manual includes several suggested report forms which can be used to record the complete details of the operating system, to quantitatively record the output level of the LNA and block downconverter, and to indicate any special problem conditions associated with the installation.

Avcom also makes a terrestrial interference survey horn (AVCOM TISH/40). This horn provides an impedance match to the input of the LNA and with 28 dB gain in the frequency range from 3.7 to 4.2 GHz. When connected to the LNA, this highly directional horn would provide an instant capability of locating and identifying sources of terrestrial interference and quantifying the degree and frequency of interference which would be expected for that installation. The reviewer did not have a survey horn available for review, but its low cost would make it a useful adjunct to the PSA-35 analyzer for many installation measurements.

Test Review

The analyzer was unpacked and ready for use within a few minutes. The only assembly involved connecting the handle and friction knobs to the case and installing the fuse in the rear of the chassis. In order to operate on battery power, a minimum of three hours of charge is necessary. The self-contained battery pack makes the unit portable and easy to carry to the source antenna system.

The most obvious characteristic of what is a very sophisticated and useful piece of test equipment is its ease of operation. When connected to an LNA and adjusted to the center transponder frequency, the display appeared instantly on the screen. The sweep span and reference level adjustments were easily made by eye and within one minute, an accurate measurement of the output of the LNA was displayed on the screen as shown in Figure 1. This is a frequency spectrum from G1 horizontal transponders.

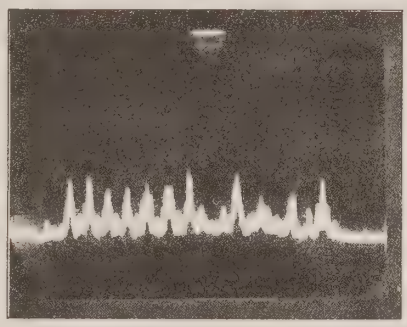


Fig. 2

Figure 2 shows the frequency sweep when the polarotor was set to the vertical transponders on G1. Figure 3 shows the vertical transponders on satellite F3. The strength of each transponder can be seen easily on this pictorial representation. These pictures came from an 85 degree K LNA connected to the type-N connector and powered by the 18 volt DC power of the Avcom analyzer. Figure 4 shows the output of that same LNA which has been block converted by a moderate priced block down-converter system.

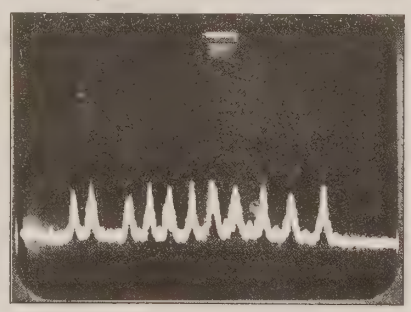


Fig. 3

Again an instantaneous representation of the gain and noise level as a function of frequency from the block down converter is obvious.

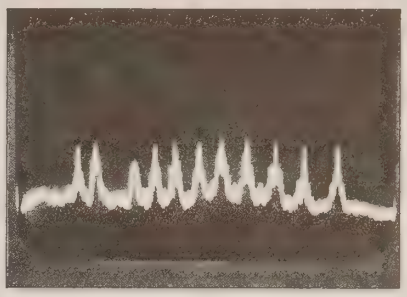


Fig. 4

Note the similarities between the two signals and the lack of signal degradation in the block downconversion process. The next step was to take a similar picture at the receiver to insure that no losses occurred in connectors or cable when the signal was transmitted into the home. The spectrum observed at the receiver was identical to that observed at the block downconverter at the satellite dish which assured quality reception at the receiver.

Polarotor Misalignment

Figure 5 illustrates a problem with misalignment of the polarotor. In this case the rotor was purposely misaligned so that a portion of the horizontal as well as vertical transponder signals were present at the output of the BDF. This is observed by noting the secondary spikes appearing between the vertical transponder signals.

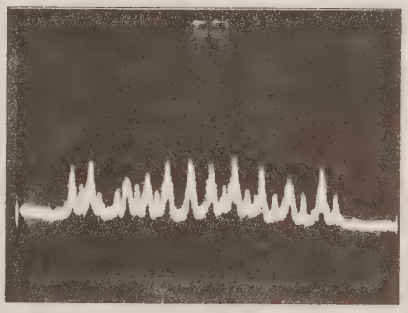


Fig. 5

By using the spectrum analyzer, it was possible to determine that the tuning meter on the receiver adequately displayed the optimum tuning at maximum deflection for correct rotor orientation. The horizontal transponder signals disappeared when the tuning meter indicated maximum signal strength in the vertical transponder position. All of these pictures were obtained within

a 15 minute period, and no elaborate set up was necessary.

When observing the output from the block down converter, it was only necessary to connect the output of the block downconverter to the rf analyzer input and to change the band select control to the appropriate frequency band for the block downconverter.

The sweep rate and span adjustments were quickly set by eye, and the reference level remained the same for each measurement. The graphic representation of the frequency spectrum of each amplifying device gave a clear picture of the quality.

The height of each of the transponder signals is roughly the same before and after amplification indicating a uniform BDC frequency response. The noise line is also constant in amplitude across the frequency band. With this information we have a way of measuring the most important variable in electronic performance of equipment of this type, the signal to noise ratio. That is, we can determine the ratio of the amplified transponder signal to the background level from internal and external noise.

Oscilloscope Camera

These photographs were made from the front of the CRT using an oscilloscope camera and polaroid film. Such a camera is inexpensive and provides an excellent method for documenting the results of the measurements. There is no slow scan signal output available for use with a chart recorder.

As was mentioned earlier, the instruction booklet includes a very helpful series of report forms which would allow accurate recording of the output level of each transponder and background noise level for permanent documentation without the need of any other measuring instrument. To make full use of the analyzer, it is recommended that such an accurate documentation be kept for future reference for any installation.

The question of the need of such a spectrum analyzer will probably arise in the mind of each installing dealer. The quality and ease of operation of this instrument combined with its low cost may make the decision much easier to make.

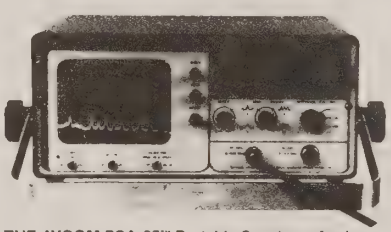
This instrument combines the needed features in a spectrum analyzer costing 10 times its price that would be found in an electrical engineering laboratory. The features, however, that are needed for quantification and identification of signal problems in the normal installation of TVRO system are all available on this instrument, and its operation is much simpler than that of more elaborate analyzers.

Any installer will find that the few moments that it takes to become proficient in operating this instrument will be saved many times over in the first installation in which it is used. Identification of problems with an installation or problems that exist from external sources can be illustrated to the home user with little difficulty.

The ability to permanently record the operating quality of an installed system or to identify recent external sources as a cause of new problems are good reasons for having this instrument available. It can be recommended as an important diagnostic tool for a variety of uses. Its cost can be justified in the time saved and in the assurance that each installation has been optimized for performance within the limitations of the equipment and the site background noise.

Once accustomed to the capabilities of this instrument, it would be difficult for an installer to go back to the normal technique of monitoring video quality and signal strength by using anything less sophisticated.

TAKE ALL THE GUESSWORK OUT OF TVRO INSTALLATIONS AND T.I. ANALYSIS WITH AVCOM'S NEW PSA-35 PORTABLE SPECTRUM ANALYZER



THE AVCOM PSA-35™ Portable Spectrum Analyzer

- Portable, only 17 pounds.
- Optimized for TVRO signals.
- Self contained rechargeable battery.
- Built in DC block and power for 4GHz and 12GHz LNA's and BDC's.
- Rugged, attractive styling.
- Large bright screen for outdoor and indoor use.
- Incredible low price, only $1965

Here's what your fellow businessmen have to say about the AVCOM PSA-35 Spectrum Analyzer.

"Bargain at this price, invaluable, a Spectrum Analyzer at 4GHz. Worth every penny spent. We're now taking jobs that we used to turn down, eliminates time consuming hit or miss methods."

Bob Franklin
Satellite Concepts
St. Albins, West Virginia

"We use it every day, we test everything with it, too bad we didn't have it 5 years ago. We used it just the other day to solve a problem at an ABC affiliate with the ABC engineer out of New York and Compucon out of Dallas."

Bruce Whitehead
Tri-Star International
Tacoma, Washington

"Extremely handy, very functional, use it for basic trouble shooting on block conversion systems and on cable systems instead of a field strength meter. Use it to show loss on RG-59 to convince customers to use higher grade cable."

Lonnie Freeman
Kaultronics
Richland Center, Wisconsin

"Anyone installing satellite TV will find the PSA-35 prevents those embarrassing moments when they turn on the customer's satellite system and get nothing."

Frank Rourk
Equinox
Alameda, California

"Worth the cost alone for T.I. trouble-shooting. Less expensive units only average T.I.. The Avcom PSA-35 Spectrum Analyzer shows the number of interfering carriers, relative aplitude, and type."

Tim Harrington
Satellite Home Entertainment
Dallas, Texas

"There's no substitute for the PSA-35 Spectrum Analyzer to get the job done. Found out that it's usable in MATV and also the two way communications field."

Robert Kirby
Fishburne Military School
Waynesboro, Virginia

Designed with you in mind.
Basic enough to begin with, sophisticated enough to grow with.

With AVCOM's PSA-35 Portable Spectrum Analyzer you can measure and document TVRO system performance after installation or service. Troubleshoot system problems by observing output signals from LNA's, BDC's, Line Amps, Splitters, and other RF signal components. Measure block system signal balance

Identify and resolve Terrestrial Interference problems quickly and precisely by displaying offending signals on the PSA-35. Customers can be shown the nature of T.I. problems for clearer understanding.

AVCOM's high performance PSA-35 Spectrum Analyzer becomes even more attractive when price is considered. The PSA-35 cost is $1965. Nothing on the market offers its performance at a comparable price.

Progressive TVRO Dealers, Repair Centers, and Manufacturers will find AVCOM's PSA-35 Spectrum Analyzer to be an indispensable instrument for rapid testing and alignment of satellite equipment. Problems that might otherwise take hours, even days to resolve, can be identified and corrected in minutes, saving time and money, as well as reinforcing customer's confidence and trust. In terms of time saved and customer good will, an AVCOM Spectrum Analyzer will pay for itself quickly

The most valuable test instrument you can own for installing and servicing TVRO systems. AVCOM's PSA-35, Don't start work without it!

For more information on the PSA-35 or any of AVCOM's fine products contact your favorite distributor, or write AVCOM, 500 Southlake Boulevard, Richmond, VA 23236, telephone (804) 794-2500. To order call, 1-800-446-2500. Visa and MasterCard welcome

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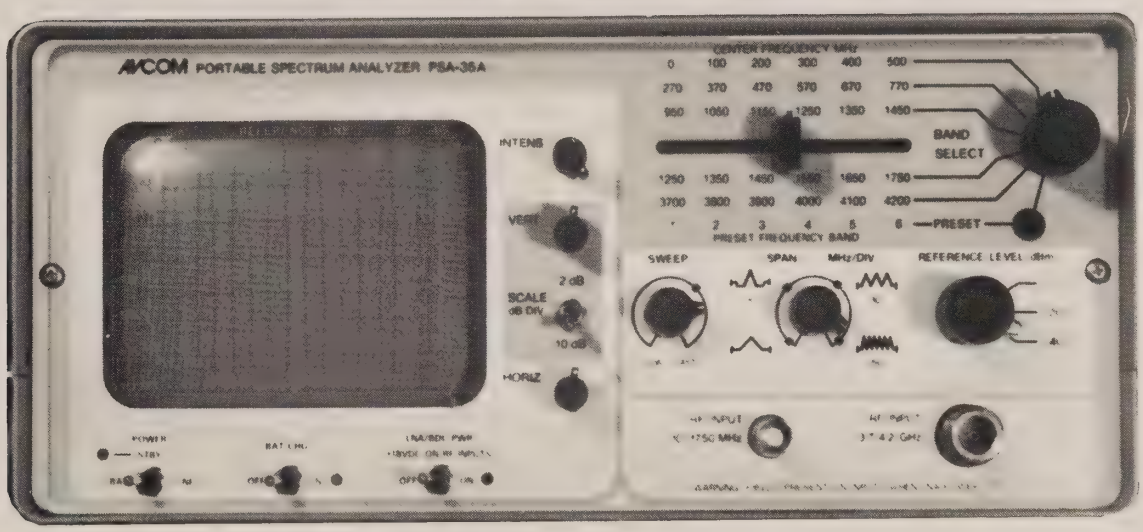
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AVCOM PSA-35A

Portable Spectrum Analyzer

10-1750 MHz 3.7-4.2 GHz



PSA-35A - $1965

Patent protection for this instrument and certain unique and proprietary circuits therein is pending.

- Frequency coverage from less than 10 MHz to over 1750 MHz; less than 3.7 GHz to over 4.2 GHz in 6 bands.
- Accurately measures wideband signals commonly used in the satellite communications industry.
- Lightweight, portable, battery operated - ideal for field test situations.
- Built in DC Block and Power for LNA's and LNB's.
- Basic enough to begin with - sophisticated enough to grow with. Ku and C band compatible.

Measure and document satellite communication system performance after installation or service. Customer should be given a copy of results per AVCOM's SASAR (Spectrum Analyzer System Analysis Report) to insure customer confidence and satisfaction.

Troubleshoot system problems by observing output signals from LNA's, BDC's, Line Amplifiers and Splitters, and other RF signal components. Measure block system signal balance.

Identify and resolve terrestrial interference problems quickly and precisely by displaying offending signals on the PSA-35A. Customers can be shown the nature of TI problems for clearer understanding.

AVCOM's high performance PSA-35A Spectrum Analyzer becomes even more attractive when the price is considered. The PSA-35A is $1965. Nothing on the market offers its performance at a comparable price.

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For more information write: AVCOM, 500 Southlake Boulevard, Richmond, Virginia 23236, or call 804-794-2500.

AVCOM'S PSA-35A
THE MOST VALUABLE TEST INSTRUMENT YOU CAN BUY FOR INSTALLING AND SERVICING SATELLITE COMMUNICATION SYSTEMS!

AVCOM PSA-35A
TECHNICAL SPECIFICATIONS

FREQUENCY COVERAGE
Low Bands: a) less than 10 to 500 MHz (70 MHz and other receiver IF frequencies).
b) 270 to 770 MHz
c) 950 to 1450 MHz
d) 1250 to 1750 MHz
e) any 500 MHz wide band from 300 MHz to greater than 1750 MHz - up to 1900 MHz special order - normally set for 400-900 MHz (customer preset band #6)
High Band: 3.7 to 4.2 GHz

INPUT CONNECTORS
Low Band: BNC (type F to BNC adapter included)
High Band: type N

INPUT CONNECTOR DC BLOCK CAPABILITY
Both input connectors are DC blocked and provision is made for insertion of +18 VDC into connector by front panel switch.

DISPLAY
10 horizontal graticule divisions (frequency) x 7 vertical graticule divisions (amplitude). Each vertical division equals 10 dB or 2 dB.

REFERENCE LEVELS
0, -20, and -40 dBm / +49, +29 and +9 dBmv

DYNAMIC RANGE
60 dB

SENSITIVITY
Selectable 2 dB/DIV or 10 dB/DIV

AMPLITUDE ACCURACY
±2 dB typical per band

RESOLUTION BANDWIDTH
300 KHz

CALIBRATION
Internal calibration, factory set

SPAN
Over 500 MHz (50 MHz/DIV) to less than 1 MHz/DIV

WEIGHT
17 pounds / 7.72 Kg

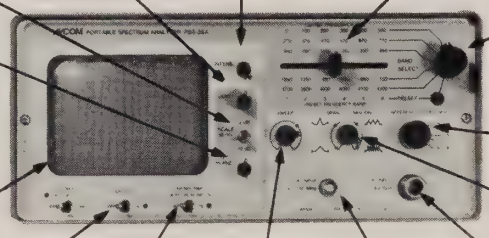
DIMENSIONS
14½" W x 5½ H x 13½" D
37 cm W x 14 cm H x 34 cm D

CIRCUITRY
Most on pluggable PC boards for rapid and easy service.

CONSTRUCTION
Attractive and durable epoxy painted heavy gauge aluminum chassis and cover, with carrying handle and bail, and line cord storage brackets which also serve as feet to stand the unit on end for easy viewing and operation in the field.

POWER REQUIREMENTS
115 Vac, 60 Hz, 65 watts - internal rechargeable gel cel battery - 220/240 volt model available

ACCESSORIES
Numerous accessories are available, refer to accessories specification sheet.



SCALE is used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV.

VERT is used to position the display on the screen.

INTENSITY controls the brightness of the display.

CENTER FREQUENCY control tunes spectrum analyzer through each band and centers signals of interest on the display.

BAND SELECT controls input frequency range to accommodate IF, BDC, and LNA output frequencies. 12 GHz block downconverter outputs can be examined. One preset band is provided for unusual test situations. If no preset values are requested at time of purchase the factory settings for this band are 400 - 900 MHz.

REFERENCE LEVEL controls the sensitivity of the display to allow signals as weak as -90 dBm as well as strong signals to be displayed. The top line of the display ("reference line") calibration value is defined by this control. Accurate measurements can be made from the reference line.

The SPAN control determines the width of the spectrum being displayed and can be adjusted to display over 500 MHz in one sweep or less than one transponder (30 MHz bandwidth) in a sweep. Symbols around the knob allow easy visualization of its function.

HORIZ is used to position the display on the screen.

Portable, attractively styled package and human engineered front panel for an instrument that is a pleasure to own and use. The PSA-35A Spectrum Analyzer is optimized for wideband signals commonly used in the satellite communications industry.

Large bright screen for outdoor and indoor use. Scale calibrated in 10 dB or 2 dB steps for accurate, repeatable measurements. 60 dB dynamic range!

BAT CHG switch recharges PSA-35A to at least 80% capacity in about 6 hours.

LNA/BDC power for feedline powering of system components via RF input connectors.

SWEEP controls rate of analyzer frequency sweep and the speed of the trace across the display. It is adjusted so that trace "flicker" just disappears. When making accurate amplitude measurements, the trace sweep rate is slowed down.

10-1750 MHz RF INPUT is used for observing BDC, IF, MATV, and other signals from 10 to over 1750 MHz. Will provide +18 VDC to power system components.

3.7-4.2 GHz RF INPUT is used when observing the output directly from an LNA. Feedline losses can be measured. Can power an LNA with +18 VDC.

AVCOM®
500 SOUTHLAKE BOULEVARD, RICHMOND, VIRGINIA 23236
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The Avcom PSA-35

This portable troubleshooter is the first spectrum analyzer specifically designed for TVRO.

PRODUCT REVIEW

By Mark Long
U.S. Bureau Chief

How to Use a Spectrum Analyzer

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SERVICE REPORT

By Stephen J. Birkill
Europe Bureau Chief

Satellite World

September 1985

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By Mark Long
U.S. Bureau Chief

The Avcom PSA-35

This portable troubleshooter is the first spectrum analyzer specifically designed for TVRO.

The spectrum analyzer is a TVRO installation and troubleshooting tool without equal. Not only can it measure signal performance in dB at each critical juncture within the system, it can also identify faulty components, check cable signal losses, and even detect the presence and intensity of terrestrial interference while a system installer is conducting a site survey. Until fairly recently, however, spectrum analyzers were restricted to the test benches of electronics engineers. Analyzers created for microwave circuit designers were too cumbersome and expensive to use in the field. Because these analyzers are frequently used as calibration standards, engineers are often leery of moving their Hewlett-Packard or Tektronix analyzers from one spot on the test bench to another, let alone sending them out on the road.

Recognizing that TVRO technicians could streamline installation and troubleshooting with more sophisticated test equipment, Avcom of Virginia, U.S.A., has developed the first portable spectrum analyzer for the private earth station industry. Avcom, one of the first U.S. manufacturers of home satellite TV receivers and accessories, is well known as the creator of TVRO products for a wide range of highly specialized applications. The PSA-35 spectrum analyzer is the result of Avcom President Andrew Hatfield's quest for the ultimate tool for the TVRO installer. Weighing less than 20 pounds (8kg), the Avcom PSA-35 is small enough to be taken just about anywhere. Since the PSA-35 will fit under a standard airline seat, satellite TV technicians can even take their analyzers on overseas expeditions. (Avcom's spectrum analyzer can be passed through any airport X-ray machine without causing damage to the unit.)

The PSA-35 has been designed to withstand the extra wear and tear inevitably experienced by any field instrument. The Avcom analyzer has a heavy-gauge aluminum chassis with a cover painted with durable epoxy. A carrying handle and AC line cord storage bracket make it easy to cart the analyzer away at a moment's notice. The cord storage bracket also serves double duty as a support stand for the analyzer, which allows the unit to be stood upright so the display can be easily viewed from above (the brightness of the display can be adjusted for shady or sunny areas). A friction knob assembly is also included for locking the handle into various positions as a support bracket for the main unit. This provides further flexibility for orienting the display at the most convenient angle for viewing.

The Avcom spectrum analyzer can be powered either from a 115V AC source or by means of an internal rechargable battery that can power the unit for up to three continuous hours in the field. The PSA-35's built-in charging circuit can completely recharge this battery to approximately 80 percent of its total capacity in a 6-hour period.

The PSA-35 also has an internal DC supply for directly powering most LNAs and block downconverters. When the LNA/BCD power switch is activated, 18V DC is sent up the line via the N and BNC connectors on the front panel. Plug-in PC boards are used throughout the interior of the PSA-35 to facilitate servicing.

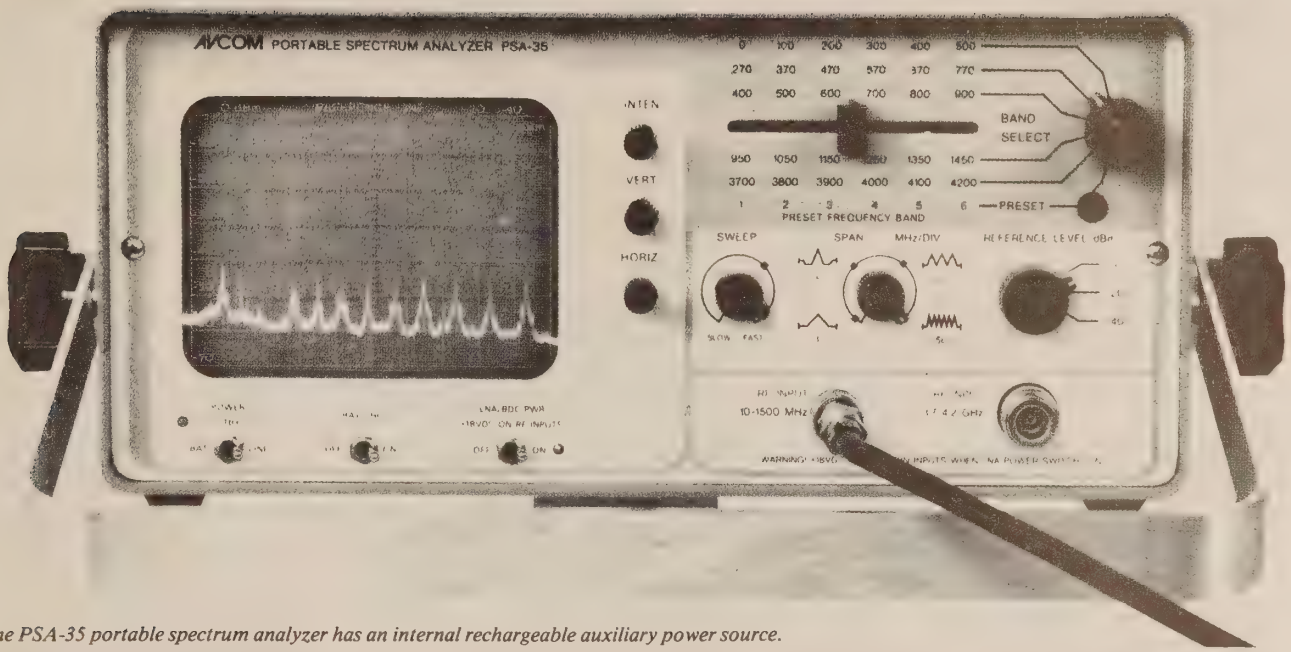
Understanding the Avcom PSA-35's Display and Controls

The vertical axis of the spectrum analyzer's viewing screen displays the amplitude of an incoming signal; the horizontal axis is referenced to the signal's frequency. A sliding frequency selector control can be adjusted by the operator so that any group of frequencies within the passband of the analyzer can be observed.

The analyzer's span control is something like the magnification control on a telescope or microscope. The operator can use it to expand the analyzer's viewing "window" out to a panoramic display of the entire 500-MHz-wide satellite band, or can use it to take a close-up view of narrow frequency segments within a single 36-MHz-wide transponder.

The unit's band-select switch allows the analyzer to directly display the signal output of a 4-GHz LNA or the intermediate frequency (IF) output of the downconverter. Both single-conversion 70- or 134-MHz IF signals can be displayed, which allows the operator to view the total downconverter output of a single transponder. Or, the entire 500-MHz-wide output bandwidth of a block downconverter can also be observed by selecting the analyzer's appropriate 500-MHz-wide frequency passband. In addition, the PSA-35 will display the block-frequency output of 12-GHz LNBs so that Ku-band systems can also be tested with the analyzer.

The operator has a choice of three distinct reference levels. The top line of the display can be set to either 0, −20, or



The PSA-35 portable spectrum analyzer has an internal rechargeable auxiliary power source.

−40 dBm (decibels referenced to 1/1,000 of a watt of power). The appropriate reference level depends on the type of signal being analyzed. A typical 4-GHz feedline signal may be as low as −70 dBm, while the output of a typical block downconverter could be −40 dBm.

The analyzer's sweep control sets the rate at which the trace moves across the display. For the purpose of making accurate signal measurements, the sweep rate should be lowered until the signal in question reaches maximum amplitude.

Applications for the Avcom PSA-35 Spectrum Analyzer

The Avcom PSA-35 spectrum analyzer will provide invaluable test results to technicians conducting site surveys, installing new systems, or troubleshooting terminals that are on the blink.

•**Site Surveys.** An auxiliary feedhorn manufactured by Avcom called the TISH (Terrestrial Interference Survey Horn) can be used in conjunction with an LNA and the PSA-35 so that sales and technical personnel can check potential earth station sites for the presence of terrestrial interference (TI). The TISH feed and LNA are bolted together and the output of the LNA connected to the N connector input of the analyzer by means of a coaxial cable. The TISH should be pointed directly toward the southern horizon and then moved eastward or westward in 20-degree increments until a sweep through the entire 360 degrees of azimuth has been completed. TI will appear as signal "spikes" that poke their way up from the illuminated trace line that displays the noise floor on the analyzer's cathode ray tube (CRT). If one complete pass reveals no interference, the installer should rotate the feed 90 degrees and sweep again. This enables the installer to detect the presence of TI cross-polarized to the initial feed orientation.

If TI is detected, the TISH and PSA-35 can be used to determine both the amplitude and the direction of the incoming interference. Alternative sites in the area can then be checked and subsequent measurements compared to results obtained at the initial site. Often, alternative locations can be found with buildings or other obstructions located between the interference source and the dish, thereby blocking out a significant portion of the incoming interference.

The PSA-35/TISH combination can also be used to directly measure the signal strength of each satellite at the site location. The TISH feed can be oriented to the correct elevation and azimuth angles for each individual satellite. By measuring the levels obtained from each of the birds and comparing the results to those obtained at sites in the clear, a technician can determine if nearby obstructions are attenuating any of the incoming signals. After a while, the site surveyor will learn to recognize the unique signal patterns for each satellite and be able to quickly and easily complete a full survey in a matter of a few minutes.

•**Installations.** Installers equipped with the PSA-35 will no longer have to drag an AC extension cord, a TV set, and a satellite receiver out to the dish in order to get the antenna to track properly. The spectrum analyzer will display the amplitude of each satellite's contingent of TV signals, providing the installer with a visual indication of the antenna's performance in tracking any satellite within the geostationary arc. The PSA-35 is also useful for properly orienting the feedhorn for maximum signal capture.

Technicians can also use the Avcom analyzer to actually measure cable loss over significant distances. Once the technician has determined the amount of loss, line amplifiers with the appropriate amount of signal gain can be added to the system to compensate for the amount of attenuation experienced. The level of gain balance across the full bandwidth of a block downconverter is also evident when the satellite's set of like-polarized transponders is displayed across the PSA-35's screen.

•**Maintenance and Troubleshooting.** Avcom has added a valuable contribution to the installation process by creating a document known as the SASAR, or Spectrum Analyzer System Analysis Report. The PSA-35 spectrum analyzer allows a technician to make precise measurements at critical points within a satellite TV system during the installation process. The data obtained

Specifications

Frequency Coverage:
Low Bands:
a) Less than 10 to 500 MHz (70 MHz & other intermediate frequencies)
b) 270 to 770 MHz
c) 400 to 900 MHz block downconverter intermediate frequencies
d) 950 to 1450 MHz
e) Customers can special-order any 500-MHz-wide band between 300 and 1900 MHz for this preset position.
High Band: 3.7 to 4.2 GHz

Display:
Ten horizontal graticule divisions display selected frequency bands and 7 vertical graticule divisions display signal amplitude, with each vertical graticule equalling 10 dB.
Reference Levels: 0, −20, and −40 dBm
Dynamic Range: 60 dB
Amplitude Accuracy: ±2 dB is typical per band
Calibration: Internal calibration, factory set
Frequency Span: From less than 1 MHz to more than 50 MHz per horizontal graticule division

Input Connectors:
Both input connectors are DC-blocked and provide for insertion of +18V DC when appropriate front-panel power switch is activated.
Low Band: BNC
High Band: Type N

Front Panel Controls:
AC Line/Battery Power On/Off Switch
Battery Charge On/Off Switch
LNA/Block Downconverter Power-up-the-Line Switch
Display Intensity Control
Vertical Trace Control
Horizontal Trace Control
Center Frequency Selector
Input Frequency Band Selector
Span Control
Sweep Rate Control
Reference Level Selector

Power Requirements:
115 VAC 60 Hz or internal rechargable battery for portable operation.

Dimensions:
14 1/2" in width by 5 1/2" in height; 13 1/2" in diameter (37cm x 14cm x 34cm)

Weight:
17 lbs (7.72kg)

is then logged into the SASAR form. If maintenance is required at a later date, the service technician has a record of system performance that will help him compare present and past performance levels. Access to SASAR data can change TVRO servicing from a hit-or-miss proposition to a more scientific process that helps the technician quickly and easily check the outputs of LNAs, downconverters, RF modulators, signal splitters, line amplifiers, coaxial relays, power dividers, isolators, and other multiple installation accessories. The effectiveness of notch and bandpass filters for removing TI can also be readily determined.

•Misceilaneous Uses of the PSA-35. Those of us with more specialized measurement needs will also find the Avcom spectrum analyzer to be extremely valuable. For example, the PSA-35 can be used to follow the progress of Intelsat satellites that are being maneuvered from one location to another by zeroing in on their telemetry beacons. New satellites can also be pinpointed in this manner before they begin transmitting TV signals. And as Stephen Birkill pointed out in his accompanying article in this issue (see page 20), the spectrum analyzer can be used to accurately determine the EIRP levels of satellites at exotic locations far removed from each spacecraft's primary coverage area. This allows a TVRO installer to precisely calculate the combination of antenna size, LNA noise temperature, and receiver C/N threshold necessary for adequate system performance for the specific site locale in question. Those readers interested in various kinds of nonvideo (SCPC, FDM/FM, TDMA, etc.) signals can also use the analyzer to identify the nature of satellite voice and data transmissions made by satellites available within their regions.

The operation manual for the Avcom PSA-35 is very well thought out, providing information on various aspects of using the analyzer. Included in the manual are a number of preliminary exercises that will easily and painlessly introduce the art of spectral analysis to dealers with little or no previous experience with similar test gear. Also included is a sample SASAR report that operators can copy and use to compile records of their installations in the field.

Now that we have mentioned many of the things that the Avcom PSA-35 can do, it's only fair that we also take a look at the differences between it and the far more expensive test bench units used for electronic design purposes. The PSA does not provide a calibrated digital frequency readout of the signal under view, nor does it have sample-and-hold capabilities like some of the newer digital analyzers now available. There is no hard copy printout of data results, nor is the screen large enough or the resolution tight enough to permit extremely fine measurements of signal levels. But that is to be expected, since the PSA-35 is priced at around U.S.$2,000, while top-of-the-line Hewlett-Packard and Tektronix analyzers sport price tags in the $30,000-to-$40,000 range.

The PSA-35 is the most powerful troubleshooting tool that I have ever had the pleasure of using. Satellite TV dealers with a large base of satellite systems in place to service will find that the Avcom analyzer will start paying for itself immediately. Installers also will find that this new product can significantly speed up the antenna alignment process. Satellite professionals of every sort will no doubt find a variety of other applications for the PSA-35 that will immeasurably aid their efforts.

Product: The PSA-35 Portable Spectrum Analyzer
Company: AVCOM of Virginia Incorporated
500 South Lake Blvd.
Richmond, Virginia 23236 U.S.A.
Telephone: 804-794-2500
Contact: Andrew Hatfield
Available: From authorized distributors or factory direct
Suggested Retail Price: U.S.$1,965

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TAKE ALL THE GUESSWORK OUT OF TVRO INSTALLATIONS AND T.I. ANALYSIS WITH AVCOM'S NEW PSA-35 PORTABLE SPECTRUM ANALYZER

ASK ANY TVRO DEALER WHO OWNS AN AVCOM PSA-35 PORTABLE SPECTRUM ANALYZER.

With AVCOM's PSA-35 Portable Spectrum Analyzer you can measure and document TVRO system performance after installation or service. Troubleshoot system problems by observing output signals from LNA's, BDC's, Line Amps and Splitters, and other RF signal components. Measure block system signal balance.



Identify and resolve Terrestrial Interference problems quickly and precisely by displaying offending signals on the PSA-35. Customers can be shown the nature of T.I. problems for clearer understanding.

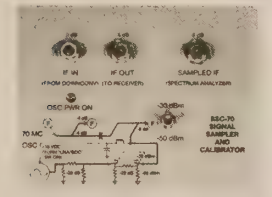
AVCOM's high performance PSA-35 Spectrum Analyzer becomes even more attractive when price is considered. The PSA-35 is $1965. Nothing on the market offers its performance at a comparable price.

Progressive TVRO Dealers, Repair Centers, and Manufacturers will find AVCOM's PSA-35 Spectrum Analyzer to be an indispensable instrument for rapid testing and alignment of satellite equipment. Problems that might otherwise take hours, even days to resolve, can be identified and corrected in minutes, saving money and time, and reinforcing customers' confidence and trust. In terms of time saved and customer good will, an AVCOM Spectrum Analyzer will pay for itself quickly.

AVCOM'S PSA-35 SPECTRUM ANALYZER BECOMES EVEN MORE VERSATILE WHEN USED WITH THESE NEW ACCESSORIES!

SSC-70 SIGNAL SAMPLER AND CALIBRATOR — AVCOM's new Signal Sampler and Calibrator, SSC-70, is designed for use with the AVCOM PSA-35 Portable Spectrum Analyzer.

The first function of the SSC-70 is to sample TVRO downconverter IF signals in the 30 to 200 MHz range. The IF signal is looped through the SSC-70 between the downconverter and the satellite receiver. Tuning voltage present in the IF coax is passed from the receiver to the downconverter unaltered. The IF signal is sampled and is available on the "SAMPLED IF" F-fitting. The PSA-35 Spectrum Analyzer is connected to this port and the IF signal can be accurately measured and examined.



If Terrestrial Interference filters are in the IF coax line, they can be tuned precisely so that video quality is preserved while T.I. is minimized.

Also an internal oscillator operating at 70 MHz, with harmonics at 140 MHz and beyond provides a quick means of checking amplitude calibration and frequency setting of the PSA-35 Spectrum Analyzer. Two output signal amplitude settings are available, one at -30 dBm and another at -50 dBm (at 70 MHz). The output level is selected by a front panel switch. The calibration oscillator is powered by the PSA-35 LNA/BDC power through the input connector. A front panel LED indicates when the oscillator is on.

TISH-40 TERRESTRIAL INTERFERENCE SURVEY HORN — AVCOM's new Terrestrial Interference Survey Horn, TISH-40, is designed to be used in conjunction with the PSA-35 Portable Spectrum Analyzer for site surveys.



The TISH-40 Terrestrial Interference Survey Horn features 18 dB gain in the 3.7 to 4.2 GHz range of frequencies. It is highly directional with high gain and rugged construction. Terrestrial Interference sources can be pinpointed quickly and accurately to increase the utility of the versatile PSA-35 Spectrum Analyzer. 1/4-20 stainless nuts pressed into the flange make LNA assembly and disassembly quick and easy.

FOR MORE INFORMATION WRITE: AVCOM, 500 Southlake Blvd., Richmond, VA 23236 or call (804) 794-2500. To order, call, 1-800-446-2500.

AVCOM's PSA-35 — THE MOST VALUABLE TEST INSTRUMENT YOU CAN BUY FOR INSTALLING AND SERVICING TVRO SYSTEMS!!

By Stephen J. Birkill
Europe Bureau Chief

How to Use a Spectrum Analyzer

This indispensable TVRO tool pinpoints problem areas and measures a system's overall performance.

As a designer and sometime installer of TVRO systems and equipment, I find the one piece of kit I most depend upon is the spectrum analyzer. When I need to know what is happening in an RF system, with regard to frequency, power levels (signal and noise power), response, bandwidth, interference, intermodulation, and all such things that cannot be left to chance, this instrument is indispensable. A multimeter will check DC power conditions, a signal level meter will assist in accurate antenna pointing, an oscilloscope will tell me a little more about video quality than I can easily deduce from a TV picture, but the ability to view the frequency domain lets me know whether the system is performing as it should, and pinpoints any problem areas.

The SA, as I shall call it here for brevity, has always been a professional's tool, most at home on the microwave engineer's test bench, not because its application is particularly specialized, but because of its cost. U.S.$20,000 is not a particularly high price for an instrument with 18- or 21-GHz microwave capabilities (some cost three times this amount), and until recently you could expect to pay up to U.S.$10,000 for any SA with an upper frequency limit above 1 GHz. Low-cost analyzers have been produced for American cable TV applications up to 450 MHz, but these are of little use in today's block IF environment. Now we can see Japanese-made general-purpose analyzers breaking the 1-GHz barrier for around U.S.$5,000, and newly emerged in the United States is the simplified, budget-priced SA specifically designed for TVRO use.

What is a Spectrum Analyzer?

The SA is a receiver. Unlike most receivers, which are tuned to a specific frequency and remain there for some time, the SA is continuously scanned, or swept, over a band of frequencies. In order for us to make sense of what the receiver sees while it scans, its output is presented as a cathode ray tube (CRT) display of signal amplitude (up the screen) against frequency (across the screen). The result is a panoramic view of the amplitudes and frequencies of all the signals present in the frequency range being scanned. Just as the familiar oscilloscope allows us to view a signal in the time domain (amplitude against time), so the SA gives us a frequency domain view of one or more signals.

Frequency Calibration

In order for this scanning receiver with panoramic display to qualify as a spectrum analyzer, it must be calibrated in both amplitude and frequency. The frequency calibration allows the user to set the limits of the band being swept. For instance he may wish to view an IF block spanning 950 to 1450 MHz, or to look at a single transponder downconverted to lie between 55 and 85 MHz, or indeed to measure a beacon at 4.199 GHz ±0.5 MHz. The display (and hence sweep) is normally calibrated at either its start (left-hand edge of display) or center, and this point will be tunable over the SA's full range, from a low of a few kilohertz (or sometimes 10 MHz) right up to the analyzer's upper limit, which might be 450 MHz, 1.8 GHz, 12.4 GHz, 22 GHz or even higher. Frequencies above 2 or 3 GHz will be tuned using harmonics of the SA's swept oscillator. Having set the sweep start or center frequency, a second control determines sweep width or frequency span, over a range from zero (sweep off), through convenient values of kHz and MHz per (horizontal) division right up to the analyzer's full sweep width, typically 2 GHz for a microwave instrument. The absolute accuracy of an SA's frequency readout is poor (±5 MHz), but careful use of a calibration oscillator will enable signal frequencies to be read to within ±1 MHz.

Log Display

The amplitude display must be able to show signal level (usually as power rather than voltage) in absolute and relative units. If a linear amplitude detector were used, a 10-fold increase in voltage would take the display from 10 percent to 100 percent of screen height, considerably limiting the dynamic range of signals which could be viewed at one time. Instead, a logarithmic detector is employed, scaled to make each large vertical division on the screen (usually one-eighth of screen height) represent 10 dB, or 10 times power ratio. The screen can then hold a total of 80 dB, representing a 100 million-to-one range of signal power (ten thousand-to-one range of voltage). In practice, the usable dynamic range may

be 70 rather than 80 dB, the bottom tenth of the screen displaying system noise. To further expand the instrument's handling of signal levels, stepped gain and input attenuation controls are included, the gain being calibrated at each step so that the user knows just what power level (in dBm; that is, dB relative to one milliwatt) is represented by each vertical division (horizontal line) on the screen. The top line of the display is usually the reference, and may be set to represent values between —90 and +30 dBm (1 picowatt to 1 watt) or more, depending upon the range of the attenuators. Absolute accuracy here may be within ±3 dB with a good instrument, and will be improved by careful calibration at the frequency of interest.

Milliwatts, millivolts, and dBm

For those unsure about dB notation, Table 1 relates dBm values to voltage and power units, in a 50-ohm system. Using an SA is a sure way to gain familiarity with the decibel. In a 75-ohm environment the relations will be different, and the more specialized 75-ohm analyzers are often calibrated not in dBm but in dB relative to microvolts (dBμV) or millivolts (dBmV), units more familiar to the cable TV technician.

Bandwidth

The spectrum analyzer also offers control of resolution bandwidth, the IF selectivity of its swept receiver. Too wide and it will be impossible to separate closely spaced carriers or sidebands, or to measure a weak signal embedded in system noise. Too narrow and the receiver will not respond to the highest modulation frequencies in the signal being analyzed. Typical maximum bandwidth is 1 MHz or 3 MHz, and the minimum will generally be around 10 kHz. Sweep rate is also adjustable, and a slow scan speed (with attendant flicker) may be necessary with certain types of signal, or when the SA is used on its narrowest resolution bandwidth ranges. Analyzers with storage displays allow these low scan rates to be used without flicker. A variable-video low-pass filter completes the signal processing controls, and enables the HF noise "grass" (and high-frequency modulation information) to be smoothed out on the CRT display.

TVRO Applications of the Spectrum Analyzer

•**Satellite Acquisition**. The SA is unique among our tools in presenting a continuous view of the entire frequency band of interest. The analyzer can be set to display a block IF of 270–770 MHz, 450–950 MHz, 950–1450 MHz, 950–1700 MHz, 1050–1550 MHz, 700–1700 MHz or whatever conversion scheme may be in use. It will show us at a glance the whereabouts of a signal in the band, how strong the signal is, how far above the noise, and to some extent the type of modulation present. This makes it ideal for use when seeking a satellite for the first time, when the receiver's tuning may not be calibrated or the active transponder is not known. By its very nature this situation is more common in the international arena than in North America, where satellites with 24 fully loaded transponders are the norm. Figure 1 (page 22) shows the Statsionar 4 Gorizont downlink band, 3650 to 3950 MHz, as seen in the United Kingdom at an IF of 850 to 1150 MHz (frequency span 50 MHz/division, bandwidth 1 MHz). Figures 2 and 3 show a 950-to-1700 MHz IF (100 MHz/division) representing 10.95 to 11.7 GHz, looking at Eutelsat I-F1 (mixed polarization) and Intelsat VA F11, respectively.

Care should be taken in connecting a spectrum analyzer to the IF feed line. Line powering with DC voltages between 12 and 28V is standard in our industry, and most spectrum analyzers (all of the general-purpose instruments) have DC-coupled 50-ohm inputs. The application of LNA/LNB/LNC/BDC DC voltage to such an analyzer's input will result in destruction of either an internal termination, an input attenuator or a mixer, requiring a costly repair job. A DC power block or bias tee is required, specified for the IF band in use. In practice most of the common 4-GHz DC blocks are adequate for IFs down to 270 MHz, for non-critical applications.

•**Beacons and other Non-video Carriers**. In seeking a signal the SA has the advantage of indicating the presence of non-video modulation formats and telemetry beacons, which may at certain times be the only indication that a satellite is in the antenna beam. In Figure 1, only Gorizont transponders 6 [-1] (the strong one) and 9 [6] (third from left) are active with television. TV transponder 7 [1] is inactive, transponder 8 [4] carries its normal SCPC, and transponders 10 [9] and 11 [11] are occupied by wide- and narrowband digital transmissions. Expanding out transponder 8 [4] (Figure 4) reveals the extent of its

Table 1. Power and Voltage Level Conversions (50-ohm systems only)

dBm	dBW	Power	Voltage (50 ohm)	dB(μV)	Power level comparison (approximate)
-107	-137	20fW	1μV	0	0 dB(μV) = -60 dB(mV)
-100	-130	100fW	2.24μV	7	
-90	-120	1pW	7.07μV	17	C-band antenna output
-80	-110	10pW	22.4μV	27	K-band antenna output
-70	-100	100pW	70.7μV	37	
-60	-90	1nW	224μV	47	
-50	-80	10nW	707μV	57	
-47	-77	20nW	1mV	60	Terrestrial TV antenna
-40	-70	100nW	2.24mV	67	C-band LNA output
-30	-60	1μW	7.07mV	77	K-band LNB output
-20	-50	10μW	22.4mV	87	Terrestrial MW antenna
-10	-40	100μW	70.7mV	97	
-9	-39	125μW	80mV	98	
-8	-38	158μW	89.1mV	99	
-7	-37	200μW	100mV	100	
-6	-36	250μW	112mV	101	
-5	-35	316μW	125mV	102	
-4	-34	400μW	141mV	103	
-3	-33	500μW	158mV	104	Receiver demodulator
-2	-32	631μW	178mV	105	
-1	-31	800μW	200mV	106	
0	-30	1mW	224mV	107	0 dBm reference
+1	-29	1.25mW	250mV	108	
+2	-28	1.58mW	283mV	109	
+3	-27	2mW	316mV	110	Multichannel cable
+4	-26	2.5mW	355mV	111	
+5	-25	3.16mW	400mV	112	
+6	-24	4mW	446mV	113	
+7	-23	5mW	500mV	114	Receiver Local Osc.
+8	-22	6.31mW	562mV	115	
+9	-21	8mW	631mV	116	
+10	-20	10mW	707mV	117	
+13	-17	20mW	1V	120	120 dB(μV) = 60 dB(mV)
+20	-10	100mW	2.24V	127	
+30	0	1W	7.07V	137	
+40	+10	10W	22.4V	147	FSS RF power
+50	+20	100W	70.7V	157	
+53	+23	200W	100V	160	DBS RF power
+60	+30	1kW	224V	167	FSS EIRP
+70	+40	10kW	707V	177	FSS EIRP
+80	+50	100kW	2240V	187	FSS EIRP
+90	+60	1MW	7070V	197	
+93	+63	2MW	10000V	200	High Power DBS EIRP

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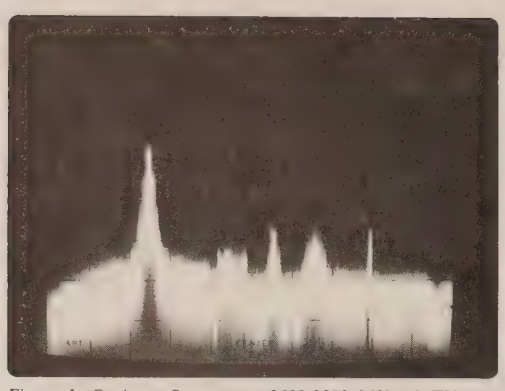


Figure 1: Gorizont 7 spectrum 3650-3950 MHz. 2 TV transponders, 2 digital and 1 SCPC. Transponder 7 [1] inactive.

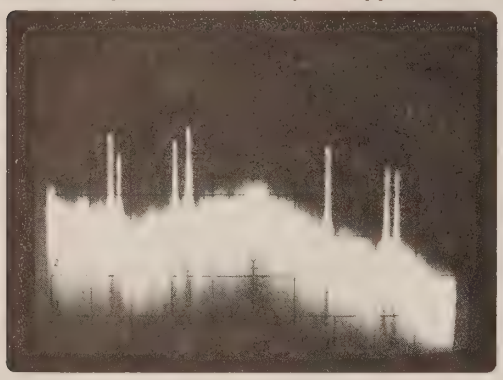


Figure 2: ECS F1 spectrum showing mixed X and Y polarization, and poor LNB response. Transponder 4 (TV5) is off.

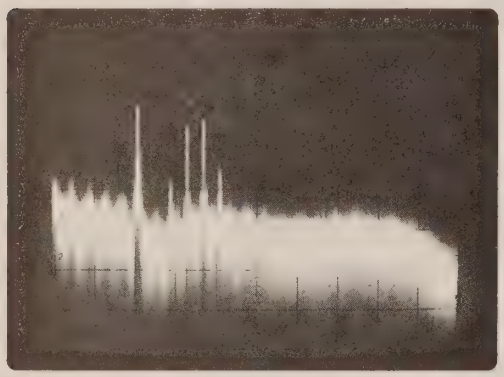


Figure 3: Intelsat VA F10 spectrum showing half-transponder transmissions in transponders 1-2 and 5-6, and amplitude ripple on feed line. Satellite-generated intermodulation products are visible (see text). Premiere channel is here operating at saturation.



Figure 4: "Close-up" view of Gorizont 7's SCPC transponder 8 [4] on northern hemispheric beam.

single-channel-per-carrier (SCPC) traffic. Looking now at Figure 2, it may not be apparent that a telemetry beacon is present at 11.45 GHz, but expanding the display (Figure 5) brings it into view (just left of center), some 57 MHz below the much stronger (and wider-band) SAT-1 signal in transponder 10 (TV5 occupies the center-screen area when its horizontally-polarized transponder 4 is active). Expanding further and reducing the resolution bandwidth (Figure 6) allows us to measure the beacon carrier.

•**Detection Sensitivity**. A further advantage in satellite-seeking is the analyzer's ability to reveal the presence of signals just 1 or 2 dB above the noise level in a bandwidth considerably less than that of a satellite TV receiver. The beacon in Figure 5 is just 1.5 dB above displayed noise in a 1-MHz bandwidth, yet is clearly distinguished. A 300-kHz bandwidth can be employed for a full-band sweep, and gives an effective 20 dB sensitivity improvement over a receiver's 30-MHz (say) IF bandwidth, for a similar signal detection criterion. The comparison is reasonable, as in each case (SA versus satellite receiver) a 3-dB carrier/noise ratio will usually correspond to positive identification of the signal above the system noise floor. When aligning an antenna this 20-dB advantage will considerably simplify initial acquisition of the satellite.

•**Antenna Alignment**. Having found the satellite, the analyzer can then be used to point the antenna accurately for maximum signal. The display is switchable to represent 1 dB (instead of 10 dB) per large division (Figure 7). This expanded vertical scale provides a very sensitive indication of signal strength, and the effects of small adjustments to an antenna or feed system are readily seen. Likewise, polarization null adjustments are best performed using the analyzer, or the final 15 dB of cross-polar rejection will be lost below the wideband receiver's noise level.

•**Interference and Intermodulation**. Adjacent satellite interference 20 dB below the wanted signal is unlikely to be noticed on a TV picture, but is quite clearly seen and quantified on the spectrum analyzer display. Potentially harmful interference may be identified and antenna adjustments or improvements made before it becomes a problem. Terrestrial microwave interference can be impossible to distinguish from a high level of system noise in a satellite TV receiver, but with the SA, the carrier-to-interference ratios can be measured and the interfering signal's frequency and direction assessed, enabling filtering or shielding solutions to be specified.

Intermodulation distortion, associated with non-linearities in an amplification or distribution system, can result in poor carrier-to-noise ratios (C/N) and the generation of spurious products within the band. In Figure 3, the effect of intermodulation in a satellite transponder may be seen. The Screen Sport and MirrorVision (formerly TEN/The Movie Channel) transmissions use half-transponder channels 3W and 4W in transponder 5-6 of Intelsat VA F11 at 27.5 degrees west. Channel spacing is 40 MHz, and the display clearly shows another pair of carriers, lower in level, spaced by a further 40 MHz at either side. These are third-order products (2f1-f2 and 2f2-f1) generated within the transponder's 10-watt TWTA and passed by its output multiplexer at a level some 12 to 15 dB below the fundamental carriers. The intermods carry a mixture of the program modulation on the two primary channels, but it's not the best way to keep an eye on the big fight while watching a movie! These intermodulation products are accepted by BTI, Intelsat, and the programmers, as they cause no interference to other services. The higher-level carrier lower down the band is that of Premiere/The Children's Channel, half-transponder channel 2W in transponder 1-2, but operating at single-carrier saturation when this shot was taken.

•**Frequency Response**. A common problem in TVRO installations is inequality in level between signals on different frequencies. Ideally the system's response should be flat, all channels arriving at the receiver within its optimum range of signal levels. Slope on the system can mean the highest level signals are on the point of generat-

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ing significant intermods while the weakest are not strong enough to overcome the input noise of the indoor unit. Either way, the result is degradation of carrier/noise ratio. Figure 2's view of Eutelsat I-F1 shows the effect of an LNB with a "hump" in its response. Noise at mid-band (1300 MHz IF) is at maximum, while at 1700 MHz it has fallen by 15 dB. This represents not a change in noise figure across the band, but in overall IF gain. Feed line loss increases with frequency, and contributes to the effect seen. Most receivers will cope quite happily with such a spread, provided the minimum gain in the band is above the point where system noise temperature would suffer. Line amplifiers often incorporate a compensating tilt into their response to counter this characteristic of the cable.

In Figure 3 a different kind of variation from flatness can be seen. Here it takes the form of an amplitude ripple. This is a sure sign of an impedance mismatch somewhere in the block IF cabling system. RF power reflected at the discontinuity generates a standing wave pattern which reinforces or cancels some of the IF energy at different frequencies, according to the length of the mismatched cable. The ripple diminishes towards the high end of the band as VSWR improves due to increasing cable loss. A severe ripple can be the cause of otherwise unexplained noisy transponders, or generally poor demodulation performance. Such variations from a flat response would be difficult or impossible to discover, let alone correct, without the spectrum analyzer.

•**Filter Response**. In the absence of a sweep generator and display, or a network analyzer, it is possible to use the spectrum analyzer to check a receiver's IF filter response. Figure 8 shows a display of an IF filter at 10-MHz/division frequency span, 3-MHz resolution bandwidth, and with video filtering (display smoothing) at maximum. The 3-dB bandwidth of 27 MHz can be measured, as can 10-dB and 20-dB bandwidths of 40 and 55 MHz. Ultimate selectivity measurement is limited in this example by the analyzer's noise floor. The test subject here was a four-element conventional IF filter—a SAW filter would reveal very much steeper skirts. In order to obtain this display the SA must be connected to the filter output, preferably by an attenuator pad to ensure the correct load impedance, and the filter must be fed with flat noise at its normal operating level. This is done with the LNA/B/C connected, either by tuning to a vacant channel or by moving the antenna to a vacant piece of sky.

In Figure 9 the same filter is shown passing a satellite TV signal. An adjacent-channel signal is visible at right, some 35 MHz away from the tuned signal, and 35 dB down. SA buffs will note the video filtering has been backed off to obtain a true peak reading, that the tuned signal carries PAL color bars with 20-MHz/volt deviation plus energy dispersal, that C/N is probably marginal, and that the receiver has inverted the frequency spectrum prior to filtering. All these facts can be deduced from the display. In the absence of the dense color subcarrier sidebands produced by the color bars, it is possible also to identify audio subcarrier frequencies, as in Figure 10.

•**Oscillator Noise and Baseband Spectrum**. The spectrum analyzer is essential if one is to measure local oscillator spectral purity, harmonics, or sideband noise. This measurement goes beyond the everyday TVRO terminal requirement, and I have not illustrated it here. Also not shown here is the use of the analyzer on the demodulated baseband, where it is a simple matter to identify the presence, levels, and frequencies of all audio and data subcarriers, and to spot problems such as a high level of noise at upper baseband frequencies.

•**Carrier-to-Noise Ratio**. This is the big one. C/N, as I'll write it here, is the fundamental measure of how well you've specified and installed the antenna and LNA/B/C for the satellite signal to be received, and influences directly the quality of the subsequent demodulated signal. What's actually measured is the ratio of carrier-plus-noise to noise, from which pure C/N can be calculated. Various methods are used, and all have their adherents. An



Figure 5: ECS F1 telemetry beacon is just visible left of center. At right is SAT-1 transmission in transponder 10.

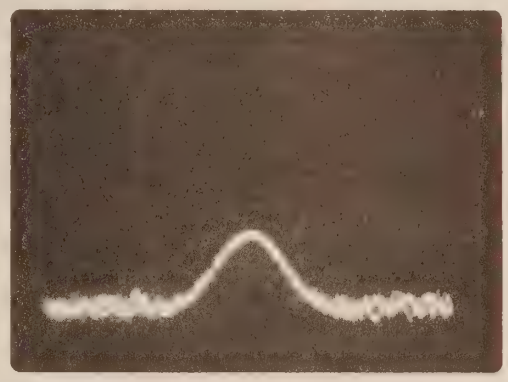


Figure 6: This shows the result of decreasing frequency span and bandwidth to analyze the ECS beacon seen in Figure 5.

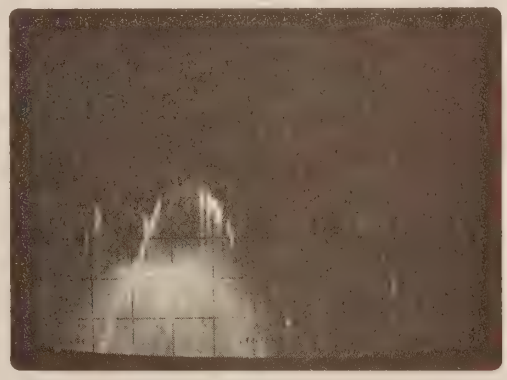


Figure 7: Switching to 1 dB per division enables fine tweaking of the antenna, even when using a TV signal.

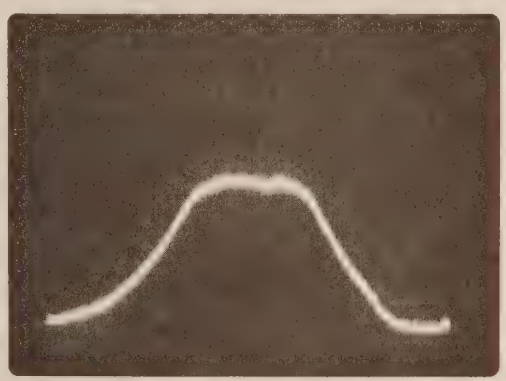


Figure 8: IF bandpass filter response may be checked using the spectrum analyzer, if the filter is fed with wideband noise and the display is smoothed with the video filter.

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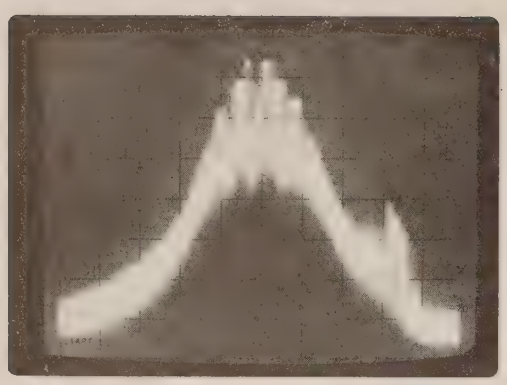


Figure 9: This is the filter of Figure 8 passing a color bar modulated TV signal. Energy peaks at white, black and sync are visible, as are the strongly-dispersed 4.43 MHz color subcarrier sidebands. Adjacent- channel transmission may be seen at right.

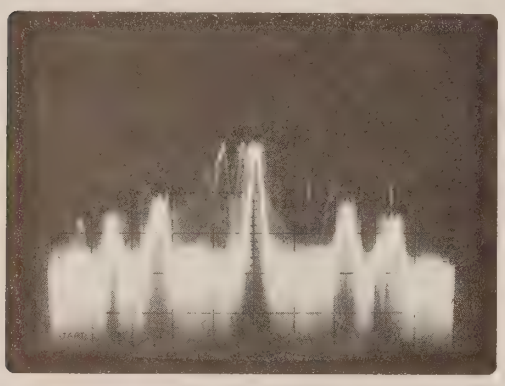
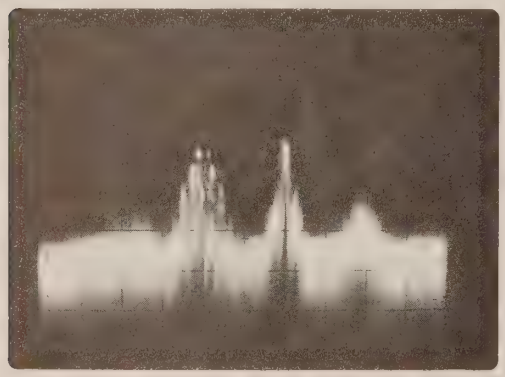


Figure 10: Lower levels of color subcarrier energy permit audio subcarrier sidebands to be seen. Subcarrier here is at 6.65 MHz.



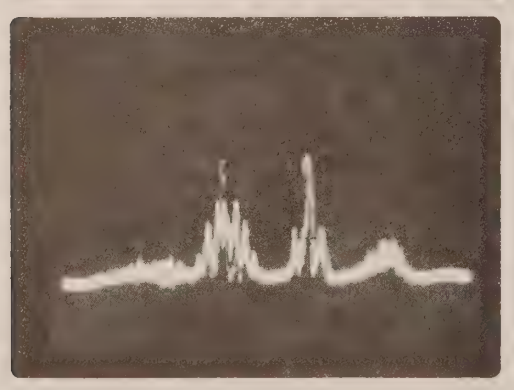


Figure 11: Read carrier levels with video filter out (above) and noise level with filter in (below). These cre Intelsat VA F10 channels 3W and 4W, with their attendant intermods.

accurate and meaningful measurement demands a filter of known characteristics (specifically its noise bandwidth) and either a precision RF power meter or a precision attenuator plus a reasonably stable RF meter. The receiver's own AGC system can in some cases provide a sufficiently reliable power indication. The large earth station operators favor the use of a special narrowband IF filter, combined with the ability to sidestep the carrier by 5 MHz or so (that's easy when you control the uplink). The US cable operators traditionally disable the receiver's AGC, and "lose" the signal by elevating the antenna away from the bird.

We could fill an issue of *Satellite World* on the subject of C/N, but thankfully I've confined myself to talking about how it can be measured using the spectrum analyzer, accurately enough for most TVRO work. This is an immensely powerful facility, as it enables calibration of a complete TVRO system and confers the ability effectively to measure power-flux density, from which we can infer EIRP. And there is the same gain in sensitivity as we noted earlier, relative to a TVRO receiver, due to the ability to measure in bandwidths much less than the 27- to 36-MHz order of the video receiver. This allows us to measure signal levels at a prospective location using a small portable antenna, and confidently extrapolate the results to determine just how large a dish is required for good TV reception.

•**Noise Bandwidth and Correction Factors**. In dealing with noise, we must be conscious of its wideband nature. Noise power is proportional to bandwidth, and a C/N value is meaningless unless a noise power bandwidth is stated. Boltzmann's constant relates noise power to both bandwidth and to the absolute temperature of the equivalent noise source resistance. In a satellite receiver the noise bandwidth is generally taken to be the same as the IF filter's 3-dB bandwidth; typical values are between 25 and 36 MHz for a full-transponder service. With the SA we shall be making the measurement in a much smaller bandwidth, 1 MHz or less, and in order to make our measurement meaningful we must be able to relate the measurement's noise bandwidth to the receiver's noise bandwidth.

We must start by knowing the analyzer's noise bandwidth. It is not the same as the value printed on the "resolution bandwidth" control. The most appropriate shape for a spectrum analyzer's IF filter is similar to that of a single-tuned circuit. This is very different from the classical "perfect" rectangular filter response approximated by SAW devices, for instance, and results in the filter's noise power bandwidth being significantly greater than its nominal (3-dB) bandwidth. Hewlett-Packard quotes a value of 1.2 for this factor in its instruments; it may be slightly different with other manufacturers (see H-P application notes 150-4 and 150-9). So we must correct our measured noise level by −0.8 dB (the ratio 1.2 expressed in dB) if we are to base our C/N calculation on the SA's resolution bandwidth.

To measure a noise level on the analyzer display, we must smooth out the thick "grassy" trace it gives, using the analyzer's video filter. This reduces the noise band's "thickness" from some 20 dB down to 1 or 2 dB, and its average level can be read quite accurately from the display. But the action of the SA's log detector is to cause the noise level to display 2.5 dB below its true value. So now we need to add 2.5 dB to the noise level read from the SA display. It is convenient to combine these two correction factors: add 2.5 dB to the measured noise power level, and subtract 0.8 dB. The net result is that we must add 1.7 dB. This is the same as subtracting 1.7 dB from the C/N we read from the analyzer's screen.

Reading the Display

Making this basic C/N measurement from the SA display is quite straightforward. We simply measure carrier level and noise level, and derive the difference in dB. Figure 11 illustrates the technique. We are looking at channels 3W (color bars again) and 4W on Intelsat VA F11, with a resolution bandwidth of 1 MHz. We can see in the top photo that the two carrier levels are 29.5 dB and 28.0 dB below the analyzer's refer-

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ence level (top line). The noise trace is too fuzzy to permit a measurement until we bring in the video filter (bottom photo). Now we can see the noise is centered on the −60-dB line, in the vicinity of both channels, so the carriers are in fact 30.5 dB and 32.0 dB above this level. Note that the video filtering (bottom photo) has made the carrier levels read lower than their true values. The rule is to measure noise with the filter in and signal with it out. All other settings must remain unchanged.

So from the SA display we have measured uncorrected C/Ns of 30.5 dB (channel 3W) and 32.0 dB (channel 4W). We now apply the −1.7-dB combined correction factor, giving us true values of 28.8 dB and 30.3 dB, in a 1-MHz bandwidth. But, you'll be thinking, surely these are carrier-plus-noise to noise ratios. In fact, since the measured values are so high, the contribution of noise level to measured carrier level can be neglected—it amounts to less than 0.1 dB, while the accuracy of the SA method of C/N measurement is only ±0.5 dB at best.

Normalizing the Result

30 dB might sound like a lot of C/N, but remember we used a 1-MHz bandwidth for the measurement. We could have used 3 MHz, or 300 kHz, or 100 kHz. Each factor of three would have changed the noise level reading by about 5 dB, but the signal level would have stayed the same. So in 3 MHz we would have measured around 25 dB C/N, in 300 kHz the reading would have been 35 dB, and the 100-kHz bandwidth would have given us a C/N in the region of 40 dB. In general, the higher the C/N measured on the display, the more accurate is the result; but when using bandwidths below 300 kHz with an FM TV signal one must be very careful to ensure the true peak carrier value is being read: not all elements of the modulating video signal will allow the display to reach its true maximum in a 100-kHz bandwidth.

Taking the 1-MHz bandwidth as a standard, we must now normalize our C/N reading to the receiver's noise bandwidth. If this is, say, 30 MHz, then we must reduce our C/N value by the (power) ratio of 30 to 1, expressed in dB. That is 10 log 30, or 14.8 dB. So our receiver's demodulator will be presented with 28.8 − 14.8 + 14 dB C/N on channel 3W, and 30.3 − 14.8 + 15.5 dB on channel 4W.

Table 2 presents a matrix of values to normalize instantly among the four most useful SA bandwidths and five typical receiver bandwidths. Remember, the 0.1-dB resolution given here doesn't mean we can measure to this degree of accuracy—there are several imponderables in the equation, not least receiver noise bandwidth; and an absolute accuracy of about ±1 dB is the best that can be achieved by this method. Relative measurements can be made to ±0.5 dB, with care. All the same this is perhaps the single most useful measurement that can be made in a TVRO system.

Table 2: Normalizing Between SA Bandwidth and Receiver Bandwidth

Spectrum Analyzer Resolution Bandwidth	TVRO receiver IF bandwidth (MHz)				
	24	27	30	33	36
100 kHz	23.8	24.3	24.8	25.2	25.6
300 kHz	19.0	19.5	20.0	20.4	20.8
1 MHz	13.8	14.3	14.8	15.2	15.6
3 MHz	9.0	9.5	10.0	10.4	10.8

Normalization factor (in dB) subtracts from SA C/N to give TVRO receiver C/N

The Analyzer Marketplace

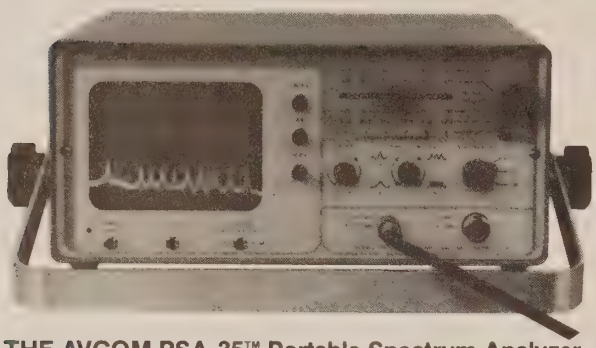
Without a doubt the best instruments for static applications are the full specification microwave spectrum analyzers, from top-name manufacturers like Hewlett-Packard and Tektronix. These SAs will cover the RF as well as IF ranges, offering a high degree of accuracy combined with features which make them convenient and simple to use. They are also bus-compatible, which refers not to their transportability but to the fact that they can be programmed and read via a computer interface. These expensive laboratory instruments are not suitable for field use, and a better choice, if you can afford it, is a professional instrument with limited microwave capability, preferably in a portable case. The 8559A is H.P.'s lowest-cost microwave analyzer, and covers the range 10 MHz to 21 GHz. The 8558B reaches 1500 MHz, enough for American block IF systems, while Tek's equivalent, the 496, covers from 1 kHz to 1800 MHz. Many instruments specified to 1500 MHz will in fact tune to 1700 MHz or higher with only marginally impaired accuracy, and should not be dismissed from consideration where 1700 MHz coverage is required. The Japanese company Ando has recently introduced a comparatively low-cost SA with this capability, and there are other oriental products worthy of our attention.

In the CATV field, Texscan has a range of inexpensively priced 75-ohm instruments that have a TVRO application outside of block conversion systems, and were until recently standard equipment in the labs of several U.S. TVRO receiver manufacturers. The bravest new showing is perhaps that of Avcom, which has introduced a portable spectrum analyzer specifically for U.S. TVRO, with 75-ohm coverage to more than 1500 MHz and a built-in BDC for the 4-GHz band (see review on page 16). This instrument offers internal BDC and LNA powering, and the rechargeable battery should make it eminently suitable for field use. ❸

Acknowledgement: Thanks are due to Satellite TV Antenna Systems Ltd for the use of an H-P 8559A/182T Spectrum Analyzer in preparing the photographs that accompany this article.

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PRODUCT REVIEW

The Avcom PSA-35 Spectrum Analyzer

Installation and on-site troubleshooting are made easier with this portable and highly versatile field test unit.

BY MARK LONG

SATELLITE DEALER

THE MAGAZINE FOR THE HOME SATELLITE SYSTEMS INDUSTRY ☐ US $4.00 ☐ NOVEMBER 1985

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The Avcom PSA-35 Spectrum Analyzer

Installation and on-site troubleshooting are made easier with this portable and highly versatile field test unit.



The PSA-35 measures signal loss, locates faulty components, and detects TI.

THE AVCOM PSA-35 PORTABLE SPECTRUM ANALYZER

BY MARK LONG

THE SPECTRUM ANALYZER IS A TVRO installation and troubleshooting tool without equal. Not only can an installer measure signal performance in dB at each critical juncture within the system, but he can also identify faulty components, check cable signal losses, and even detect the presence and intensity of terrestrial interference while conducting a site survey. Until recently, however, spectrum analyzers were restricted to the test benches of electronics engineers. Analyzers created for microwave circuit designers were too cumbersome and expensive to use in the field. Because these analyzers are frequently used as calibration standards, engineers are often leery of moving their Hewlett-Packard or Tektronix analyzers from one spot on the test bench to another, let alone sending them out on the road.

Recognizing that TVRO technicians could streamline installation and troubleshooting with more sophisticated field test equipment, Avcom has developed the first portable spectrum analyzer for the private earth station industry. Avcom, one of the first U.S. manufacturers of home satellite TV receivers and accessories, is well known as a developer of products for a wide range of highly specialized TVRO applications. The PSA-35 spectrum analyzer is the result of a quest by Andrew Hatfield, president of Avcom, for the ultimate tool for the TVRO installer. Weighing less than 20 pounds, the PSA-35 is small enough to be taken just about anywhere.

The PSA-35 has been designed to withstand the extra wear and tear inevitably experienced by any field instrument. It has a heavy-gauge aluminum chassis with a cover painted with durable epoxy. A carrying handle and AC line cord storage bracket make it easy to cart the analyzer away at a moment's notice. The cord storage bracket also serves double duty as a support stand for the analyzer, which allows the unit to be stood upright so the display can be easily viewed from above (the brightness of the display can be adjusted for shady or sunny areas). A friction knob assembly is also included for locking the handle into various positions as a support bracket for the main unit. This provides further flexibility for orienting the display at the most convenient angle for viewing.

The Avcom spectrum analyzer can be powered either from a 115-volt source or by means of an internal rechargable battery that can power the unit for up to three continuous hours in the field. The PSA-35's built-in charging circuit can completely recharge the battery to approximately 80 percent of its total capacity in six hours.

The PSA-35 also has an internal DC supply for directly powering most LNAs and block downconverters. When the LNA/BCD power switch is activated, 18 volts are sent up the line via the N and BNC connectors on the front panel. Plug-in PC boards are used throughout the interior of the PSA-35 to facilitate servicing.

The vertical axis of the spectrum analyzer's viewing screen displays the amplitude of an incoming signal; the horizontal axis is referenced to the signal's frequency. A sliding frequency selector control can be adjusted by the operator so that any group of frequencies within the passband of the analyzer can be observed.

The analyzer's span control is similar to the magnification control on a telescope or microscope. The operator can use it to expand the analyzer's viewing "window" to a panoramic display of the entire 500 MHz-wide satellite band, or to take a close-up view of narrow frequency segments within a single 36 MHz transponder.

Displays RF and IF

The unit's band-select switch allows the analyzer to directly display the signal output of a 4-GHz LNA or the intermediate frequency (IF) output of the downconverter. Both single-conversion 70- or 134-MHz IF signals can be displayed, allowing the operator to view the total downconverter output of a single transponder. The entire 500-MHz output bandwidth of a block downconverter can also be observed by selecting the analyzer's appropriate frequency passband. In addition, the PSA-35 will display the block-frequency output of 12-GHz LNBs so that Ku-band systems can also be tested with the analyzer.

The operator has a choice of three reference levels.

The operator has a choice of three distinct reference levels. The top line of the display can be set either to 0, −20, or −40 dBm (decibels referenced to 1/1,000 of a watt of power). The appropriate reference level depends on the type of signal being analyzed. A typical 4-GHz feedline signal may be as low as −70 dBm, while the output of a typical block downconverter could be −40 dBm.

The analyzer's sweep control sets the rate at which the trace moves across the display. For the purpose of making accurate signal measurements, the sweep rate should be lowered until the signal in question reaches maximum amplitude.

The Avcom PSA-35 spectrum analyzer will provide invaluable test results for technicians conducting site surveys, installing new systems, or troubleshooting terminals that are on the blink. An auxiliary feedhorn that Avcom calls the TISH (terrestrial interference survey horn) can be used in conjunction with an LNA and the PSA-35 so that sales and technical personnel can check potential earth station sites for the presence of terrestrial interference (TI). The TISH feed and LNA are bolted together and the output of the LNA is connected to the N connector input of the analyzer by means of a coaxial cable. The TISH should be pointed directly toward the southern horizon and then moved eastward or westward in 20-degree increments until a sweep through the entire 360 degrees of azimuth has been completed. TI will appear as signal "spikes" that poke their way up from the illuminated trace line that

displays the noise floor on the analyzer's cathode ray tube (CRT). If one complete pass reveals no interference, the installer should rotate the feed 90 degrees and sweep again. This enables the installer to detect the presence of TI cross-polarized to the initial feed orientation.

Evaluating TI

If TI is detected, the TISH and PSA-35 can be used to determine both the amplitude and the direction of the incoming interference. Alternative sites in the area can then be checked and subsequent measurements compared to results obtained at the initial site. Often, alternative locations can be found with buildings or other obstructions located between the interference source and the dish, thereby blocking out a significant portion of the incoming interference.

The PSA-35/TISH combination can also be used to directly measure the signal strength of each satellite at the site location. The TISH feed can be oriented to the correct elevation and azimuth angles for each individual satellite. By measuring the levels obtained from each of the birds and comparing the results to those obtained at sites in the clear, a technician can determine if nearby obstructions are attenuating any of the incoming signals. After a while, the site surveyor will learn to recognize the unique signal patterns for each satellite and be able to quickly and easily complete a full survey in a matter of a few minutes.

Installers equipped with the PSA-35 will no longer have to drag an AC extension cord, a TV set, and a satellite receiver out to the dish in order to get the antenna to track properly. The spectrum analyzer will display the amplitude of each satellite's contingent of TV signals, providing the installer with a visual indication of the antenna's performance in tracking any satellite within the geostationary arc. The PSA-35 is also useful for properly orienting the feedhorn for maximum signal capture.

Measure Cable Loss

Technicians can also use the Avcom analyzer to actually measure cable loss over significant distances. Once the technician has determined the amount of loss, line amplifiers with the appropriate amount of signal gain can be added to the system to compensate for the amount of attenuation experienced. The level of gain balance across the full bandwidth of a block downconverter is also evident when the satellite's set of like-polarized transponders is displayed across the PSA-35's screen.

SASAR data can make servicing more scientific.

Avcom has made a valuable contribution to the installation process by creating a document known as the SASAR, or Spectrum Analyzer System Analysis Report. The PSA-35 spectrum analyzer allows a technician to make precise measurements at critical points within a satellite TV system during the installation process. The data obtained is then logged into the SASAR form. If maintenance is required at a later date, the service technician has a record of system performance that will help him compare present and past performance levels. Access to SASAR data can change TVRO servicing from a hit-or-miss proposition to a more scientific process that allows the technician to quickly and easily check the outputs of LNAs, downconverters, RF modulators, signal splitters, line amplifiers, coaxial relays, power dividers, isolators, and other multiple-installation accessories. The effectiveness of notch and bandpass filters for removing TI can also be readily determined.

Special Applications

Those of us with more specialized measurement needs will also find the Avcom spectrum analyzer to be extremely valuable. For example, the PSA-35 can be used to follow the progress of Intelsat satellites that are being maneuvered from one location to another by zeroing in on their telemetry beacons. New satellites can also be pinpointed in this manner before they begin transmitting TV signals. It can also be used to accurately determine the EIRP levels of satellites at exotic locations far removed from each spacecraft's primary coverage area. This allows a TVRO installer to precisely calculate the combination of antenna size, LNA noise temperature, and receiver CN/R threshold necessary for adequate system performance for the specific site locale in question. Those interested in various kinds of nonvideo (SCPC, FDM/FM, TDMA, etc.) signals can also use the analyzer to identify the nature of voice and data transmissions available within their regions.

The operations manual for the Avcom PSA-35 is well thought out, providing information on various aspects of using the equipment. Included in the manual are several preliminary exercises that will easily and painlessly introduce the art of spectral analysis to dealers with little or no previous experience with similar test gear. Also included is a sample SASAR report that operators can copy and use to compile records of their installations in the field.

What It Can't Do

Now that we have mentioned many of the things that the Avcom PSA-35 can do, it's only fair that we also take a look at the differences between it and the more expensive test bench units used for electronic design purposes. The PSA does not provide a calibrated digital frequency readout of the signal under view, nor does it have sample-and-hold capabilities like some of the newer digital analyzers now available. There is no hard-copy printout of data results, nor is the screen large enough or the resolution tight enough to permit extremely fine measurements of signal levels.

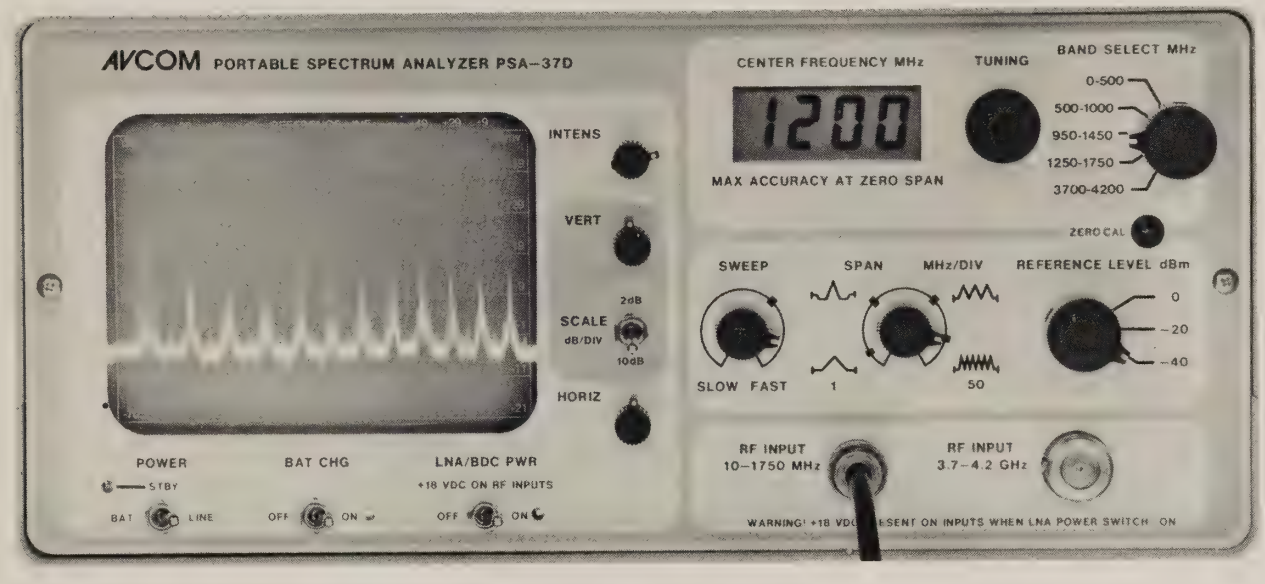
The PSA-35 is the most powerful troubleshooting tool that we have ever had the pleasure of using. Satellite TV dealers with a large base of satellite systems to service will find that the Avcom analyzer will start saving them money immediately. Installers also will find it can significantly speed up the antenna-alignment process. Satellite professionals of every sort will no doubt find a variety of other applications for the PSA-35 that will immeasurably aid their efforts. Investing in this product should be worthwhile. □

Mark Long is author of the 1985 World Satellite Almanac *and* The World of Satellite Television.

PRODUCT: The PSA-35 Portable Spectrum Analyzer
COMPANY: Avcom of Virginia
500 South Lake Blvd.
Richmond, VA 23236
(804) 794-2500
CONTACT: Andrew Hatfield
AVAILABLE: From authorized distributors or factory direct
SUGGESTED RETAIL PRICE: $1,965

NEW!!

AVCOM PSA-37D
PORTABLE SPECTRUM ANALYZER
WITH DIGITAL FREQUENCY READOUT



PSA-37D - $2475

- Frequency coverage from 10 to 1750 MHz and from 3.7 to 4.2 GHz, in 5 bands.
- Accurate 4 digit LCD frequency readout.
- Accurately measures wideband signals commonly used in the satellite communications and CATV industries.
- Lightweight, portable, battery or line operated — perfect for field test situations.
- Ku and C band compatible.
- Built in DC Block and power for LNA's and LNB's.
- 220/240 volt models available.

The **PSA-37D Portable Spectrum Analyzer** is AVCOM's answer to all your downlink installation, service, and maintenance problems. Frequency coverage is from 10 to over 1750 MHz, and from 3.7 to 4.2 GHz in 5 bands. Frequency readout is shown in MHz on a four digit LCD front panel display. The **NEW** digital readout allows fast, easy and accurate operation of your AVCOM **PSA-37D Portable Spectrum Analyzer.**

The NEW digital readout allows you to identify and resolve terrestrial interference problems quickly and precisely by displaying offending signals and their frequencies.

The **PSA-37D** has a built in DC block with +18 VDC for powering LNA's and BDC's, calibrated signal strength amplitude display and internal battery with charger. Selectable vertical sensitivity of either 2dB or 10dB/DIV is standard. The portable battery or line operated, **PSA-37D** with digital frequency readout is ideal for field test situations and is the perfect instrument for the critical alignment and tracking measurements necessary for maximum signal reception.

All areas of the satellite communication industry from Dealers, Installers, Repair Centers, Maintenance Contractors, and Manufacturers to single and multiple System Owners will find AVCOM's PSA-37D to be an indispensable instrument for rapid testing and alignment of satellite equipment.

AVCOM'S PSA-37D
THE MOST VALUABLE TEST INSTRUMENT
YOU CAN BUY FOR
INSTALLING, MAINTAINING
AND SERVICING
SATELLITE COMMUNICATIONS SYSTEMS

AVCOM PSA-37D
TECHNICAL SPECIFICATIONS

FREQUENCY COVERAGE
Low Band: a) 10 to 500 MHz
b) 500 to 1000 MHz
c) 950 to 1450 MHz
d) 1250 to 1750 MHz
High Band: 3.7 to 4.2 GHz

INPUT CONNECTORS
Low Band: BNC (type F to BNC adapter included)
High Band: type N

INPUT CONNECTOR DC BLOCK CAPABILITY
Both input connectors are DC blocked and provision is made for insertion of +18 VDC into connector by front panel switch.

FREQUENCY DISPLAY/ACCURACY
4 digit LCD frequency readout/Accuracy ± 4 MHz nominal, at zero span.

REFERENCE LEVELS
0, -20, and -40 dBm/+49, +29 and +9 dBmv

SENSITIVITY/DYNAMIC RANGE
Selectable 2 db/DIV or 10 dB/DIV/Dynamic range +60 dB

AMPLITUDE ACCURACY
±2 dB typical per band

RESOLUTION BANDWIDTH
300 KHz

CALIBRATION
Internal calibration, factory set

SPAN
Over 500 MHz (50 MHz/DIV) to less than 1 MHz/DIV

WEIGHT
17 pounds/7.72 Kg

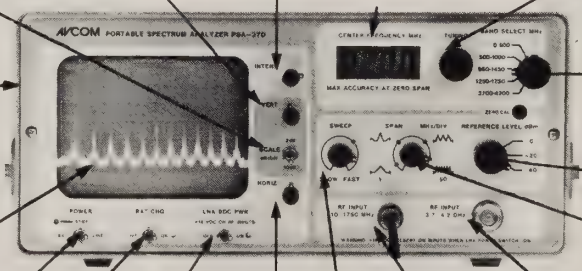
DIMENSIONS
14½" W x 5½" H x 13½" D
37 cm W x 14 cm H x 34 cm D

CIRCUITRY
Most on pluggable PC boards for rapid and easy service.

CONSTRUCTION
Attractive and durable epoxy painted heavy gauge aluminum chassis and cover, with carrying handle and bail, which also serve as feet to stand the unit on end for easy viewing and operation in the field.

POWER REQUIREMENTS
115 Vac, 60 Hz, 65 watts—internal rechargeable gel cel battery—220/240 volt model available.

ACCESSORIES
Numerous accessories are available, refer to accessories specification sheet.



SCALE is used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV.

INTENSITY controls the brightness of the display.

VERT is used to position the display on the screen.

CENTER FREQUENCY is a 4 digit LCD display that allows you to accurately read the frequency in MHz of a signal centered on the PSA-37D display.

CENTER FREQUENCY TUNING fine tunes the PSA-37D through the selected band and centers signals of interest on the display while their frequency is read on the CENTER FREQUENCY READOUT.

Portable, attractively styled package and human engineered front panel for an instrument that is a pleasure to own and use. The PSA-37D Spectrum Analyzer is optimized for wideband signals commonly used in the satellite communications industry.

BAND SELECT controls input frequency range to accommodate IF, BDC, and LNA output frequencies. Frequency ranges are 0 to 500 MHz, 500 to 1000 MHz, 950 to 1450 MHz, 1250 to 1750 MHz and 3.7 to 4.2 GHz.

REFERENCE LEVEL controls the sensitivity of the display to allow signals as weak as -95 dBm as well as strong signals to be displayed.

Large bright screen for outdoor and indoor use. Scale calibrated in 10 dB or 2dB steps for accurate, repeatable measurements. 60 dB dynamic range!

SPAN determines the width of the spectrum being displayed and can be adjusted to display over 500 MHz or less than one transponder in a sweep.

POWER switch has 3 positions for Battery Operation, Standby, and AC Line Operation.

3.7-4.2 GHz RF INPUT is used when observing the output directly from an LNA. Feedline losses can be measured. Can power an LNA with +18 VDC.

BAT CHG switch recharges PSA-37D to at least 80% capacity in about 6 hours.

HORIZ is used to position the display on the screen.

LNA/BDC power for feedline powering of system components via RF input connectors.

SWEEP controls rate of analyzer frequency sweep and the speed of the trace across the display.

10-1750 MHz RF INPUT is used for observing BDC, IF, MATV, and other signals from 10 to over 1750 MHz. Will provide +18 VDC to power system components.

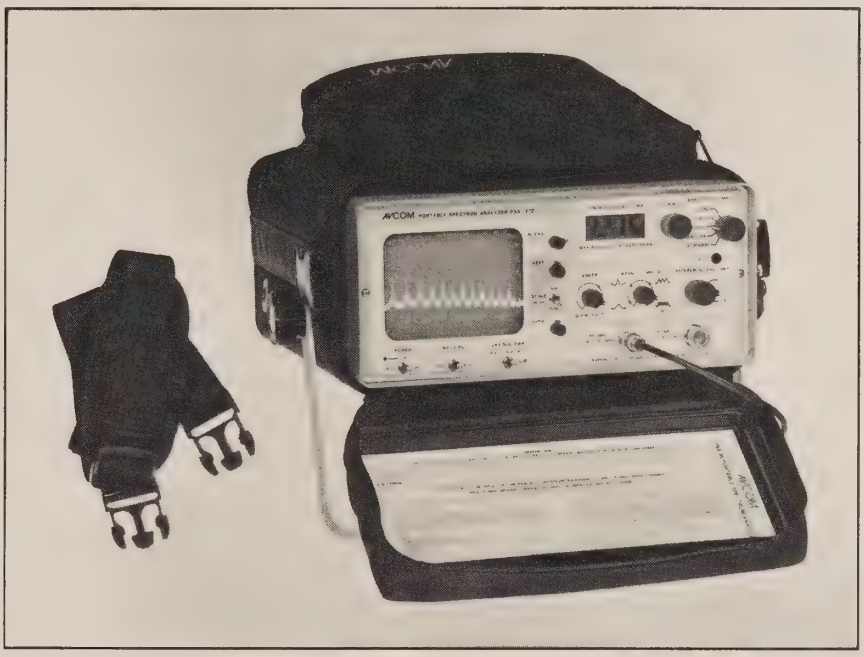
AVCOM® 500 SOUTHLAKE BOULEVARD, RICHMOND, VIRGINIA 23236
TELEPHONE 804-794-2500 TELEX 701-545 FAX 804-794-8284

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The Avcom PSA-37D

Avcom proves that being in the right place at the right time can be the key to success.

by RICHARD MADDOX



Avcom, one of the first companies formed when the home satellite industry started to take off in the late 1970s, has been making spectrum analyzers since 1985. Their first design, the PSA-35A, was the first analyzer designed specifically with the home satellite dealer/installer/servicer in mind. It's still being sold today.

The PSA-37D, introduced two years later, is basically a 35A with a digital display of center frequency, an improved tuning method, and a longer persistence phosphor CRT.

Both units weigh the same (about 17 pounds with the three gel cell batteries installed) and use the same chassis design. The front panels are laid out in similar fashion with the biggest difference being the use of a slide control to tune the center frequency on the 35A versus the much easier to use rotary tune control on the 37D.

ANALYZER ABILITIES

A spectrum analyzer is similar to an oscilloscope. A trace, actually a single point of light, is rapidly swept from left to right (horizontal) across the display face while being modulated in an up and down direction (vertical) by the input signal.

In an oscilloscope, the horizontal trace represents time and the input signal is viewed only in the time domain. In a spectrum analyzer, the input is viewed in the frequency domain. Both show amplitude as a vertical function. The 37D spectrum analyzer views a band of frequencies whose width can be adjusted from very narrow (simulating an oscilloscope) to a full 500 MHz window. The width is set by the span control.

The 37D also allows you to vary the sweep rate. In most uses, the rate will be at the fastest setting to provide the fastest retrace time. For a more accurate measurement, the rate must be slowed down and the span narrowed to zoom in on the signal of interest.

In most applications in the home satellite industry, there are only three controls that are normally used on the 37D. The tuning control, span control, and sweep rate control, so it is simple to use.

PRODUCT FEATURES

The 37D is a versatile test instrument that can examine five frequency ranges in 500 MHz blocks. The ranges cover the C-band downlink band (3.7-4.2 GHz), the standard block conversion range (950-1450 MHz), the Euro-standard extended block range (1250-1750 MHz), and two low RF ranges that cover the VHF/UHF/HAM/cable TV/cellular range (10-500 MHz and 500-1000 MHz).

The C-band range uses a type-N input connector, while all the other ranges use a BNC connector. The +18 volts (which drops to about +16 volts after the unit has been on for a while) is available for powering LNAs, LNBs, or line amplifiers. This voltage is controlled by a front panel on/off switch.

The 37D can be used with either C or Ku-band LNBs since there is a normal/reverse switch on the bottom of the chassis. What this does is reverse the CRT display for C-band LNBs so that the channel relationships look "normal," i.e., channel one will be at the left of the display, channel 24 at the right. When switching to view Ku-band LNBs, you must remember to flip this slide switch to normal or else the display will be backwards.

The dynamic range of the instrument is from 0 dBm to -95 dBm in three overlapping ranges – 0 to -65 dBm, -20 to -85 dBm, and -40 to -95 dBm. In most applications, the -20 dBm reference level will work best.

One slight drawback to the 37D is that the instrument must be "recalibrated" each time you turn it on if you want to be able to give definitive signal level or frequency measurements. For general use (verifying there is a signal present, doing a TI survey, performing cross-pol nulling), simply setting the vertical and

horizontal controls to 12:00 should put the instrument close to calibration.

WARRANTY

The 37D comes with a one-year parts warranty but only a 180-day labor warranty. The gel cells and CRT are not covered by this warranty. All repairs must be done at the Avcom facility in Virginia and all returned product must be shipped prepaid.

USING THE ANALYZER

In normal use, the analyzer will probably need to be shaded from the direct sun in order to clearly see the CRT. Avcom makes an accessory called the TISH-40, a Terrestrial Interference Survey Horn, which also makes a great sunshade when you aren't doing TI surveys.

The unit is constructed with an aluminum and steel chassis so it is fairly robust (and heavy). It does, however, contain a CRT which can be damaged by rough handling (i.e., dropping off a ladder). An optional accessory, the AVSAC carrying case, is available if you plan to use the 37D in the field. It should be noted that it's more for scratch protection and ease of carrying than for real protection.

The unit is powered off the AC line or off three, internal 6-volt gel cells. It is important to never allow the unit to completely discharge the gel cells because this can damage them to the point where they won't accept a charge. A front panel battery charge on/off switch will automatically charge the batteries when the 37D is in standby mode. A red LED indicates that the unit is charging.

The only time I've had any problems with the 37D is when using it in extremely cold weather. I have had occasions when the trace did not appear until the unit was warmed up. However, once the trace does appear it seems to hang in there even when being used for hours in very cold temperatures. Cold temperatures also seem to affect battery charge life, so I recommend using it on the AC line in cold temperatures.

APPLICATIONS

The main jobs for the 37D in the satellite field are to determine if there is TI in the area, to determine if there is a signal present on a coax cable at the receiver or at the LNB, to maximize the received signals through nulling cross-pol, and peaking the antenna and feed.

In most cases, the 950-1450 MHz range and BNC input will be used. Because of this, it is essential that a good type-F to BNC adapter be available to adapt the 75-ohm satellite coax cables to the instrument input.

TI surveys can be accomplished without using the TISH-40 feedhorn (simply connect an LNB and point it), but in some cases the TI signals will be low enough for you to assume they couldn't be causing interference. The TISH-40, with 18 dB of gain, allows a more accurate measurement of TI direction and environmental shading effects.

The 37D can be used to set the position of the Polarotor by viewing the output of the LNB with the polarity tune mode active. Nominally a 1.0 to 1.8 millisecond pulse width change will bring in the two polarities. If the cross-pol cannot be evenly off-tuned with the skew control, or if the cross-pol cannot be nulled out, then the feedhorn can be physically rotated while observing the 37D to null out the opposite polarity.

I personally find that using an audible peaking indicator (like the Tweaker) is easier to use than the analyzer for dish tracking. For a fixed or commercial installation, a Tweaker alone is not enough since you typically must also record the received signal levels. When verifying that you have the most signal possible, the 37D has a 2 dB/division setting that allows you to fine tune the feed or antenna pointing. When in the 2 dB mode, you will definitely need a sunshade over the display since the brightness is cut down.

The 37D has many uses beyond those normally found in the home satellite field. It is useful for antenna aiming and link applications, including aligning the same microwave links that cause the TI!

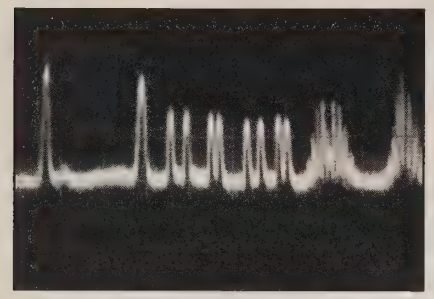
In TV distribution systems, the 37D can measure signal level, signal-to-noise ratios, cable tilt, and even video-to-audio carrier levels between channels. The low band (10 to 500 MHz) covers the VHF, low UHF (up to about channel 18), and most cable TV channels. Switching to the 500-1,000 MHz

PRODUCT SPECIFICATIONS

Frequency ranges:
Five 10 to 500 MHz
500 to 1000 MHz
950 to 1450 MHz
1250 to 1750 MHz
(can be special-ordered with a different 500 MHz range, between 300 and 1900 MHz)
3.7 to 4.2 GHz

Inputs:
Two BNC used for ranges below 1900 MHz
Type-N used for 3.7 to 4.2 GHz range
(DC blocks are standard on both inputs. Switchable +18 volts available.)

Frequency readout: 4 digit
LCD frequency display accuracy: ±4 MHz nominal (at zero span)
Amplitude accuracy: ±2 dB with band
Dynamic range: 60 dB
Reference levels: 0, -20 dBm, -40 dBm (referenced to top line of display after the unmodulated trace is set between two display graticule calibration marks)
Resolution bandwidth: 250 KHz
Span: from 50 MHz/div to less than 1 MHz/div
Power, AC: 115 VAC/60 Hz, 65 watts (220 volt option available)
Battery: 3 6-volt gel cell batteries
Power to LNB: +18 VDC, 400 mA
Weight: 17 pounds
Dimensions: 14.5 inches x 5.5 inches x 13.5 inches



Various types of satellite transmissions as viewed on an analyzer. From left to right, two unmodulated data carriers, eight compressed-video SCPC carriers, and two modulated video carriers.

range will bring in the rest of the UHF band and any remaining cable channels on 550 MHz systems.

You can verify the output level and frequency of RF modulators in satellite receivers, VCRs, and other products in seconds with the 37D set for about 55 MHz and with a fairly narrow span.

You can also verify that there is video present at the video output jacks by setting the unit to 4 MHz with a narrow span. The sweep control can then be used to somewhat sync up the 37D to the video signal.

Using a piece of stripped coax as an antenna, or using a UHF remote receiver antenna, you can also verify that UHF remotes are working by tuning to the transmitter's frequency, again using a fairly narrow span, and looking for a transmission spike when a remote button is pressed.

I used the 37D to troubleshoot a network scalar analyzer and RF generator I had rented. By plugging in the 37D to the RF generator, I found out the 4 GHz signal was not being swept. Reseating the RF plug-in module and reconnecting the 37D verified that the signal was being properly swept.

PRICING

The list price for the PSA-37D is $2,475. It can be purchased directly from Avcom or from various satellite equipment distributors.

The TISH-40 TI survey horn is $127 ($97 when purchased with the analyzer). The AVSAC carrying case is $89.

UPGRADING TO A 37D FROM A 35A

If you own a PSA-35A unit, you can upgrade it to PSA-37D for $775. Avcom replaces the front panel, adds the LCD and driver circuits, replaces the CRT, and recalibrates it for you.

Avcom is located at 500 Southlake Blvd., Richmond, VA 23236. Their phone number is: (804) 794-2500; FAX (804) 794-8284. ◆

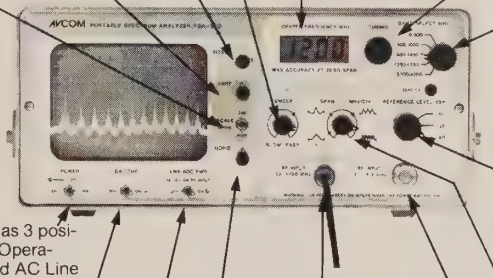
AVCOM®

NEW PSA-37D

AVCOM INTRODUCES THE NEW PSA-37D PORTABLE SPECTRUM ANALYZER WITH DIGITAL FREQUENCY READOUT.

AVCOM's NEW PSA-37D Portable Spectrum Analyzer has a 4 digit front panel frequency readout and is controlled by a rotary frequency adjustment control. Frequency ranges that the PSA-37D cover are 0 to 500 MHz, 500 to 1000 MHz, 950 to 1450 MHz, 1250 to 1750 MHz and 3.7 to 4.2 GHz. The PSA-37D Portable Spectrum Analyzer is lightweight, battery operated, ideal for field test situations. A built-in DC block with +18 VDC powers LNAs and BDCs with the flip of a switch. All other performance characteristics and features are the same as the PSA-35A which has become an industry standard for satellite communications work. The PSA-37D sells for $2475.

500 SOUTHLAKE BOULEVARD
RICHMOND, VIRGINIA 23236
TELEPHONE (804) 794-2500
FAX: 804-794-8284
TELEX: 701-545



SWEEP controls rate of analyzer frequency sweep and the speed of the trace across the display.

INTENSITY controls the brightness of the display.

VERT is used to position the display on the screen.

SCALE is used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV.

CENTER FREQUENCY is a 4 digit LCD display that allows you to accurately read the frequency in MHz of a signal centered on the PSA-37D display.

CENTER FREQUENCY TUNING fine tunes the PSA-37D through the selected band and centers signals of interest on the display while their frequency is read on the CENTER FREQUENCY READOUT.

BAND SELECT controls input frequency range to accommodate IF, BDC, and LNA output frequencies. Frequency ranges are 0 to 500 MHz, 500 to 1000 MHz, 950 to 1450 MHz, 1250 to 1750 MHz and 3.7 to 4.2 GHz.

REFERENCE LEVEL controls the sensitivity of the display to allow signals as weak as -85 dBm as well as strong signals to be displayed.

SPAN determines the width of the spectrum being displayed and can be adjusted to display over 500 MHz or less than one transponder in a sweep.

3.7-4.2 GHz RF INPUT is used when observing the output directly from an LNA. Feedline losses can be measured. Can power an LNA with +18 VDC.

10-1750 MHz RF INPUT is used for observing BDC, IF, MATV, and other signals from 10 to over 1750 MHz. Will provide +18 VDC to power system components.

HORIZ is used to position the display on the screen.

LNA/BDC power for feedline powering of system components via RF input connectors.

BAT CHG switch recharges PSA-35A to at least 80% capacity in about 6 hours.

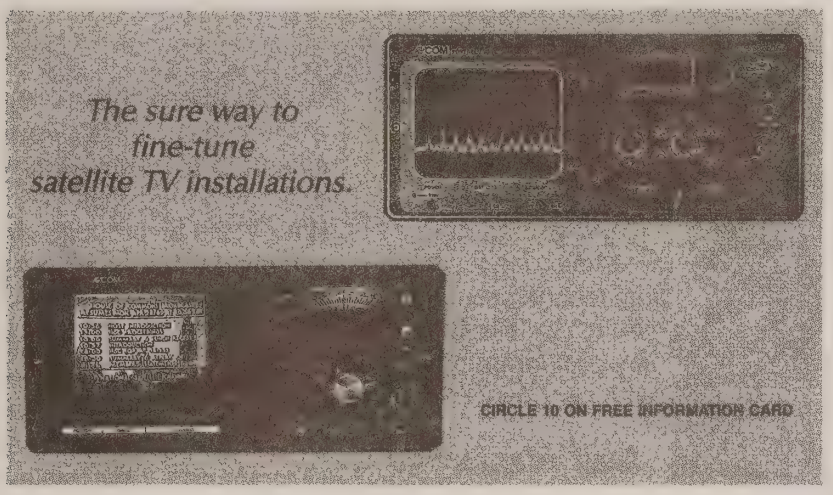
POWER switch has 3 positions for Battery Operation, Standby, and AC Line Operation.

Circle No. **12** on Reader Service Card

FOR MORE INFORMATION CALL:
AVCOM OF VIRGINIA
500 SOUTHLAKE BLVD. • RICHMOND VA • 23236
(804) 794-2500 • FAX: (804) 794-8284

EQUIPMENT REPORTS

AVCOM PSA-37D Spectrum Analzyer and PTR-25A Portable Test Receiver



It's possible to install a satellite-TV system without any test equipment—but it's not recommended for any professional installer who intends to stay in business very long! Test equipment can help an installer adjust a satellite system for maximum performace. On strong satellite transponders, the improvement from fine tuning might not be noticed. But for marginal signals, every bit of tweaking can make a dramatic difference.

We recently had the opportunity to install a satellite-TV system using two tools made just for the job: the PSA-37D Portable Spectrum Analyzer and the PTR-25A Portable Test Receiver. Both are from Avcom of Virginia, Inc. (500 Southlake Blvd., Richmond, VA 23236).

Aiming a satellite antenna can be tricky business, and we can only sketch the details here. But it's worth noting that if your antenna aim is off a quarter of an inch, you can miss the satellite by hundreds of miles! In satellite TV, Signals are received from geosynchronous (apparently fixed) satellites located in an arc some 22,300 miles over the equator; the satellites are spaced at 2-degree intervals.

The first step in aiming a dish is to fix it on the highest satellite in the arc. That particular satellite varies with location, but it is always the satellite located closest to due south. Armed with a compass, protractor, and aiming data for the installation site, the installer aims the dish by adjusting its azimuth and elevation. The next step is to move to other satellites, and to fine tune the position of the mount so that the dish can track the arc properly.

Experienced installers can get a dish to track the satellite arc reasonably well without any test equipment. But it's virtually impossible to get a system operating to its *maximum* potential without making some measurements. As first-time installers, we relied heavily on Avcom's spectrum analyzer and portable test receiver. And thanks to that equipment, our installation was problem-free.

Unlike most spectrum analyzers, the battery-powered PSA-37D is designed specifically for satellite TV installation and servicing. It provides five operating ranges in 500-MHz blocks. The highest range is the C-band downlink frequencies, 3.7–4.2 GHz. Second is the 950–1400 MHz band, the output of standard LNB's or low-noise block downconverters. (The LNB is an amplifier that boosts the extremely weak signals collected from the dish, and converts them to a lower frequency so that they can be transmitted over standard coaxial cable to a satellite receiver.) A third range is the European standard block downconverter frequencies from 1250–1750 MHz. Two lower RF ranges, 1–500 and 500–1000 MHz, makes the analyzer useful for a wide variety of service applications including cable TV and cellular telephone. The analyzer can provide power to the LNB (+18 volts DC) through its BNC connector.

The main advantage of using a spectrum analyzer instead of a receiver when peaking a dish is that it's far more sensitive. Small changes that might not be noticed in a video image can be seen on the analyzer's CRT.

Another use for the analyzer actually comes before the dish needs to be aimed. The first step of any satellite installation is the *site survey*. For a successful installation, you must be able to "see" the satellites without obstructions such as trees or buildings. The site must also be free of terrestrial interference or TI. The spectrum analyzer (used with a either a standard feedhorn and LNB or a special feedhorn sold by Avcom), can quickly pinpoint sources of TI.

As valuable as a spectrum analyzer is, there are some tasks that are easier with a satellite receiver. One example is targeting the first satellite. An error of a couple of degrees could cause the dish to receive signals from the wrong satellite, making all further attempts to align the dish onto the satellite arc frustrating. A spectrum analyzer can't identify the satellite the antenna is fixed on. But an installer armed with a receiver can quickly identify a "bird."

For example, on our initial aiming attempt, we were happy to find a signal with only minor adjustment. But when we looked at the picture on the PTR-25A portable test receiver, we knew something was

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EQUIPMENT REPORT

continued from page 22

wrong because the picture we were viewing, SportsChannel, was not on Galaxy 2 (our highest satellite), but on one satellite to the east!

The receiver also offers an handy audio "Squawk" that provides an audio indication of signal strength. It's a easy way to peak the dish position because it allows an installer to keep his eyes on his work instead of on a signal meter or spectrum analyzer.

The PTR-25A portable test receiver has a list price of $1395. The PSA-37D portable spectrum analyzer has a list price of $2475. Thanks to the time they can save an installer, they should pay for themselves in short order. And the improved performance they can potentially bring to a dealer's installed systems should keep his customers happy—and coming back for more! Ω

AVCOM BRINGING HIGH TECHNOLOGY DOWN TO EARTH

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TELEPHONE 804-794-2500 - FAX 804-794-8284

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AVCOM's PTR-25A
Portable Test Receiver



PTR-25A - $1395

AVCOM's Portable Test Receiver, the PTR-25A, sets a new standard of performance for a comprehensive battery operated satellite receiver. The built-in 4.5" B & W TV offers reduced power consumption and longer battery life than comparable color units. Picture definition and "sparklie" resolution is excellent with the B & W display. A full range of outputs are available for observing the 70 MHz IF signal including terrestrial interference, if any, on AVCOM's comprehensive line of spectrum analyzers.

A large, easy to read signal strength meter is located on the front panel and an audible signal strength indicator function is provided for dish peaking without any need to monitor the meter or display. As the signal nears maximum strength the pitch of the audible tone rises and allows the dish to be peaked to a fraction of a dB.

Very attractive styling (that coordinates with the AVCOM PSA-37D Spectrum Analyzer) and rugged packaging make the PTR-25A Portable Test Receiver an important and necessary addition to the Installer/Dealer's test equipment. An attractive and functional Cordura carrying case is available.

FEATURES

***C and Ku Band Compatible**

***High Threshold Sensitivity**

***Portable - Battery Operated**

***Comprehensive Rear Panel Outputs**

***Audible & Visual Signal Strength Indicators**

***Internal Recharging Circuitry and AC Supply**

***Extended Battery Life with Fast Recharge**

***Polarotor and Polarizer Controls**

***IF Output for Spectrum Analyzer**

AVCOM's PTR-25A - Portable Test Receiver
Technical Specifications

RF INPUT	
Input Level	-70 dBm to -25 dBm
Frequency	950 - 1450 MHz
Impedance	75 Ohms
Power Gain	18 dB Typical
Noise Figure	-12 dB Typical
Image Rejection	35 dB Typical
Connector Type	Type BNC (BNC to F Adapter Supplied)
AGC	Auto
IF	
Automatic Gain Control	>25 dB Dynamic Range
Frequency	70 MHz
Bandwidth	30 MHz
VIDEO	
Impedance	75 Ohms
Return Loss	>25 dB
Clamping	Fully Active, >40 dB
Output Level	1 Volt Peak to Peak, adjustable
Polarity	Switch Selectable, Black to White, Normal or Inverted
De-emphasis	Standard NTSC
AUDIO	
The PTR-25A incorporates a tunable audio demodulator.	
Frequency	5.0-8.0 MHz
Frequency Response	30 Hz to 15 KHz ±1 dB
De-emphasis	75 Microsecond
Output Level	.7 Volt Peak to Peak
Harmonic Distortion	<1.8% Specifications
PHYSICAL	
Dimensions	14.5"W x 5.5"H x 13.5"D
Weight	17 lbs. / 7.72 kg
Power Requirements	100 to 130 VAC,60Hz, 45 Watts or Internal Rechargeable Batteries
Operating Temperature	5 to 40 C

POL 2 BUTTON. Push-button switch provides signal to activate Polarotor II type polarizer.

POLARIZER/POL 1 SWITCH Selects between Polarotor I type and twister I type polarizers.

POL 1 V/H - Adjusts skew on Polarotor I type polarizers.

SCAN TUNE - Activates a continuous scan of the 950-1450 MHz Band.

METER ADJUST - Adjusts the sensitivity of the signal strength meter.

4.5" B&W TV Module

Audio Tuning - 5 to 8 MHz tunable

NORMAL/INVERT SWITCH For normal video viewing or inverted for reversed syn polarity.

TRANSPONDER SELECT - The large knob on the control module provides continuous tuning of satellite transponder.

SQUAWK ON/OFF - Provides audible signal strength indication, eliminates the need to visually monitor the meter.

STANDARD TELEVISION CONTROLS Power, Volume, VHF Tuning, UHF Tuning.

POWER
BAT - Turns the instrument on and power is supplied by internal rechargeable battery.
STBY - Instrument is functionally off although power is present inside chassis.
LINE - Turns instrument on when power is available from a 115 VAC line source.

BAT CHARGE - Battery is connected to internal charging circuit when switch is in the "ON" position and line cord is attached to a 115 VAC power source.

LED INDICATOR Acknowledges use of LNB power supply.

RF INPUT - BNC connector for connecting most popular 950-1450 MHz BDC's or LNB's.

REAR PANEL

AC LINE CORD - Used to supply 115 VAC operating voltage

FUSE 1 - AC Line fuse, rating 1 amp.

+18 VDC INPUT - External power to operate PTR-25A with an external supply. Center pin voltage.

FUSE 2 - Battery pack fuse, rating 4 amp.

POWER SOURCE SWITCH - Select between internal battery and external 18 volts DC source

TERMINAL STRIP FOR POLAROTOR I AND II TYPES

Polarotor I type uses terminal 1 for pulse, terminal 2 for +5V, and terminal 3 for ground.

Polarotor II type uses terminal 3 for ground, and terminal 4 for signal.

Polarizer uses terminal 6 and 7.

External meter uses terminal 7 and 8.

TV ANTENNA INPUT - VHF, UHF input for internal TV.

VIDEO AND AUDIO OUTPUT - To use with a color monitor or VCR

BASEBAND OUTPUT - Unfiltered, unclamped video to be used for external descramblers and audio demodulators.

70 MHz LOOP - Switchable active or passive to be used with external 70 MHz TI filters.

INTERNAL BATTERY PACK (NOT SHOWN) The internal battery pack provides-up to 2 or more hours operation on a full charge, depending on duty cycle. An 80% battery charge is attained with a 6 hour charge.

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Radio World®

Buyers Guide — Reprinted from January 22, 1992

AVCOM PSA-65A Versatile, Economical

by Andy Hatfield
President
AVCOM of Virginia, Inc.

RICHMOND, Va. With a frequency range of less than 2 MHz to greater than 1000 MHz and sensitivity of −95 dBm, the PSA-65A has proven itself to be a versatile, powerful and cost-effective portable spectrum analyzer.

The analyzer weighs only 18 pounds and comes standard with a built-in rechargeable battery pack.

The PSA-65A is an effective instrument for field testing of RF systems, classroom instruction, satellite system alignment, electronic countermeasures, cellular and production use. In fact, the applications of the PSA-65A are limited only by the user's imagination.

PSA-65A expanded

AVCOM has expanded the capability of the PSA-65A by designing and producing a line of accessories such as an FM demod, 10 kHz resolution bandwidth, oscilloscope interface, AM detector, frequency extenders, log periodic antenna and preamplifier.

The FM demod allows the operator to listen to FM signals that are displayed on the PSA-65A CRT via the internal speaker or Audio Out jack. This jack can be used to drive external speakers or headphones, which is particularly useful when identifying FM station signals or those from TV stations, various two-way radio systems and satellite and microwave downlinks. It also is ideal for listening for the "noise source," as well as other signals in a security countermeasures application.

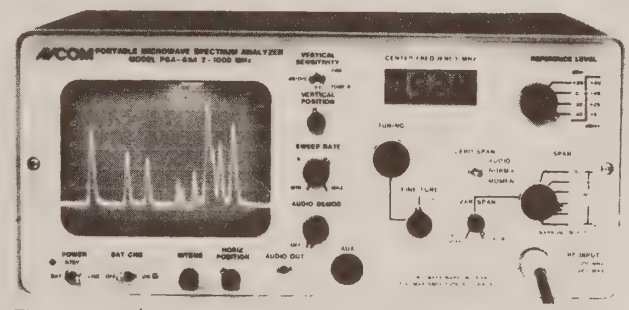
The installation of the 10 kHz resolution bandwidth filter increases the frequency coverage by reducing the low end of the unit from 2 MHz to 200 kHz.

The oscilloscope interface option was designed to give the operator the ability to output the CRT display of the PSA-65A to an oscilloscope. The advantage of this capability is realized when the PSA-65A is interfaced with a digital oscilloscope. This way the information of the PSA-65A can be digitized and stored to be recalled at a later date or output to a computer via the RS-232, HP-IB or other computer interface port of the digital oscilloscope.

The AM detector option enables the operator to "hear" the vertical deflection of the CRT trace of the PSA-65A. It originally was designed for utility companies to detect RF leaks and interference. When a signal pops up on the screen, it will either create a tone or change the frequency of the existing tones.

Greater versatility

AVCOM developed frequency extenders to allow the PSA-65A greater versatility by increasing the frequency coverage. Standard frequency extenders include 1 to 2 GHz, 2 to 3 GHz, 950 to 1450 MHz and 3.7 to 4.2 GHz. Other frequency bands may be customer specified.



The Avcom PSA-65A Portable Microwave Spectrum Analyzer

Frequency extenders consist of a mixer and oscillator tuned to downconvert a signal so that the output falls between 2 and 1000 MHz, which is the input range of the PSA-65A. The sensitivity and accuracy of the PSA-65A are not affected during this operation; however, there is a 10 dBm conversion loss.

This loss may be accounted for mathematically by adding 10 dBm to actual readings or eliminated by the use of a preamplifier.

Frequency extenders are particularly useful for cable operators who need the capability to align satellite antennas, check signals on cables and monitor off-air signals. They also are necessary for the official who employs the PSA-65A to locate RF transmitters (bugs) that operate higher than 1 GHz. AVCOM has manufactured the 1 to 2 GHz and 2 to 3 GHz frequency extenders in one package for this application.

AVCOM's LPA-1000 is a high-performance precision-machined log periodic antenna for the PSA-65A, as well as for use with other equipment. The LPA-1000 covers a frequency range from 140 MHz through 1200 MHz. The LPA-1000 is only 49 inches (125 cm) in length and weighs four pounds (1.8 kg). A BNC connector is standard.

Enhance performance

AVCOM's high-performance RF preamplifier, the RFP-24, was designed to enhance the performance of the LPA-1000 log periodic antenna, and for other applications where low noise signal amplification is required. The RFP-24 dramatically improves the sensitivity of any spectrum analyzer or frequency extender to frequencies in excess of 2 GHz. Used with AVCOM's PSA-65A portable spectrum analyzer, signals weaker than one microvolt can be detected.

Technical specifications for model RFP-24 include 22 dB gain through 2 GHz, a noise figure of 2.2 dB at 1.2 GHz, a VSWR of 2.5:1, and 50 ohms input and output impedance. Power may be supplied by the PSA-65A front panel Aux jack or any source of 12 VDC.

The PSA-65A portable spectrum analyzer, we believe, is a real value. The operator can tailor the instrument to meet his specific requirements by adding the proper options and accessories.

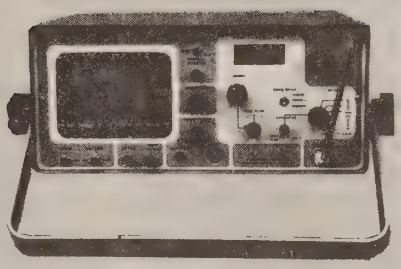
■ ■ ■

For information on the PSA-65A, contact Charlie Odom at AVCOM of Virginia, Inc.: 804-794-2500; fax: 804-794-8284.

AVCOM PSA-65A Spectrum Analyzer

An inexpensive, quality spectrum analyzer from 2 MHz–1 GHz.

CIRCLE 43 ON FREE INFORMATION CARD



VERY LIKELY, MANY OF YOU HAVE always wanted a *professional* spectrum analyzer, whether for troubleshooting, or experimentation. However, every time you've looked at a catalog and seen prices that start in the $10–20K range, your jaw drops. Unless you're in a large corporate firm with megabuck budgets, you've probably had *no* chance of getting one until now.

With the Model PSA-65A 2 MHz–1 GHz Spectrum Analyzer from AVCOM Corp. (500 Southlake Blvd., Richmond, VA 23236), *that* problem is *over*. The basic cost is $2,675, and many reasonably priced accessories, like an FM demodulator ($185), high-performance attachable log-periodic antennas (about $239), and carrying case ($89.95) are available. At 11.5- × 5.5- × 13.5 inches and a weight of 18 pounds, it's as portable as a standard portable oscilloscope.

General controls and jacks

The PSA-65A has numerous, convenient, and well-labeled controls. They're all on the front panel, and grouped according to function in a color-coded gray-and-white format. The PSA-65A is powered by 120- volt, 60-Hz AC, but can run using an internal gel-cell battery with recharger. The POWER switch has BAT, STANDBY, and LINE positions. The battery charger (BAT CHG) can operate in any POWER SWITCH position, and needs about three hours to charge sufficiently for prolonged use.

The AUDIO DEMOD potentiometer is the volume control for listening to AM or FM broadcasts, and has a built-in SPST ON/OFF switch. However, the PSA-65A won't let you observe a spectrum and listen to audio simultaneously. That would require having two separate tuners, one to be swept through the observable spectrum, and the other tuned to the center frequency.

An earphone jack is provided (AUDIO OUT), and an AUX jack is for present and future optional accessories. The SWEEP RATE control varies the speed of the sweep-rate generator. For maximum accuracy in vertical amplitude measurements, the sweep is set as slow as possible. A BNC jack is used for RF INPUT from 2 MHz–1 GHz range, and a maximum power of 15 dBm, or 31.6 mW.

Vertical amplitude controls

The CRT is located in the upper left of the front panel, and the graticule is calibrated vertically in dBm and dBmV, and horizontally in dBmV. Those two units are dB relative to a milliwatt (mW) and a millivolt (mV), respectively. The PSA-65A has VERTICAL POSITION and REFERENCE LEVEL knobs, and a VERTICAL SENSITIVITY switch to select between 10 dB/div or 2 dB/div (for both dBm and dBmV). The *reference level* allows vertical expansion by vertically moving the signal-noise floor, and is calibrated with the *vertical sensitivity* set to 10 dB/div, but not 2 dB/div.

Horizontal and tuning controls

The main function switch on the PSA-65A is ZERO SPAN, which determines whether the instrument is operating in AUDIO, NORM, or MOMEN mode. In AUDIO mode, the PSA-65A displays an AM or FM broadcast by quadrature detection, at the frequency indicated on the 4-digit CENTER FREQUENCY MHZ LCD. The quadrature detector is mainly for FM, but also demodulates AM intelligibly.

In NORM mode, the PSA-65A displays a frequency spectrum, being calibrated when the VAR SPAN knob is in the CAL position. As it's rotated toward ZERO SPAN, the observed spectrum segment on the CRT expands horizontally about the center frequency, narrowing in bandwidth. The ZERO SPAN + XSC SETTING OF THE VAR SPAN knob is an ideal, because the time waveform on the CRT is never a pure sinusoid, since the horizontal SPAN control has a finite nonzero bandwidth filter for each setting (more below).

The AUDIO mode automatically gives a ZERO SPAN display. The MOMEN mode momentarily does so, to let the user alter the center TUNING frequency easily. In NORM mode, there's a 0.5 second lag between moving the TUNING knob, and the corresponding update of the LCD.

In the AUDIO and MOMEN modes, no such lag exists, and any TUNING knob rotation is instantly reflected on the LCD. The center frequency is controlled by two potentiometers, one a 10-turn version for main TUNING, and a single-turn FINE TUNE control. The FINE TUNE appears to have a range of about 7 MHz, but is asymmetric and nonlinear in effect.

For each horizontal SPAN setting, there's a nonzero filter bandwidth resolution, which gives rise to the time effects observed at ZERO SPAN (discussed shortly). The resolution is 3 MHz at 100 MHz/div, 1 MHz at 50 MHz/div, 300 kHz at 10 MHz/div, 150 kHz at 5 MHz/div, and normally 75 kHz at either 1 MHz/div or 200 kHz/div. The user can also opt for an additional 10 kHz filter for the 200 kHz/div setting, if desired.

One good way to observe the effects of those filters is by observing a TV station spectrum. The AM video is always 4.5 MHz below the FM audio. If you center the video on the CRT with the VAR SPAN control set to CAL, and then rotate it to ZERO SPAN, you'd see the actual time waveform, just as if you were using an oscilloscope.

That waveform would be completely visible as the VAR SPAN is rotated toward ZERO SPAN. In the CAL position, you'd see the spectrum, but possibly also see a spurious representation of the time

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SPECTRUM ANALYZER

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waveform superposed on it, for certain settings of the horizontal SPAN. That is because of the techniques used to design the instrument, not because of modulation.

Thus, VAR SPAN doesn't really produce a 0 Hz span, since that would be a pure monochromatic tone. The TV waveform containing the sync pulses is really a time-dependent voltage, whereas the video spectral peak is a true frequency-dependent amplitude (voltage or power). If you repeat for the audio, you'll see the time-dependent audio waveform, and it'll change amplitude and frequency as the sound varies. However, the presentation, while that of an oscilloscope, not a spectrum analyzer, is untriggered and drifts across the screen.

Horizontal calibration

The horizontal needs to be calibrated each time the instrument is turned on and/or the HORIZ POSITION is moved, which can be somewhat tricky if not done carefully. The user tunes a signal peak onto the center of the graticule, with the VAR SPAN knob set to the CAL position. The user then rotates the VAR SPAN knob counterclockwise, watching that peak. It'll expand in width, but should, ideally, remain centered, and not deflect to either side.

If it does deflect, then as the VAR SPAN is rotated, the user alternates between the VAR SPAN and HORIZ POSITION knobs, to recenter the now-expanding peak. The reason for alternating between them is that as the peak expands, it's maximum becomes more difficult to locate, since the display appears to be flatter. Thus, rotating each knob in turn gives greater accuracy and control, and an opportunity to maintain a visual reference on the maximum as the peak changes shape.

Once completed, with the VAR VAR SPAN set to ZERO SPAN and the

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SPECTRUM ANALYZER

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peak again centered, the user then sets the VAR SPAN to CAL. The peak should compress to its minimum observable width, and the user moves the HORIZ POSITION knob to recenter the peak one final time. If done properly, rotating the VAR SPAN control toward ZERO SPAN should expand, but result in no horizontal deflection. The procedure should become habit after a couple of trys.

The graticule and CRT

The vertical axis is calibrated in both dBm and dBmV; there's a 49 dB difference between the two scales. The top horizontal line of the graticule indicates numbers in both dB and dBmV, the reason being that the graticule was a holdover from an earlier instrument. The numbers indicate the interpretation associated with the top horizontal line, for the various three lower settings of the REFERENCE LEVEL knob; the upper setting (20 dBm or 69 dbmV) isn't represented. The PSA-65A also updates the CRT every 5 seconds, causing it to flash briefly.

Conclusion

Even with the minor limitations like the TUNING knob lag on the LCD in NORM mode, the nonlinearity of the FINE TUNE knob, the reverting to a time-dependent display in the ZERO SPAN position of the VAR SPAN knob, and the need for horizontal calibration, this is a *very* impressive instrument for the price. It allows spectrum-analyzer capability at a fraction of normal cost, and will popularize the concept of using one as a complement to an oscilloscope. AVCOM is certainly moving toward their goal of putting a low-cost spectrum analyzer on every RF technician's workbench.

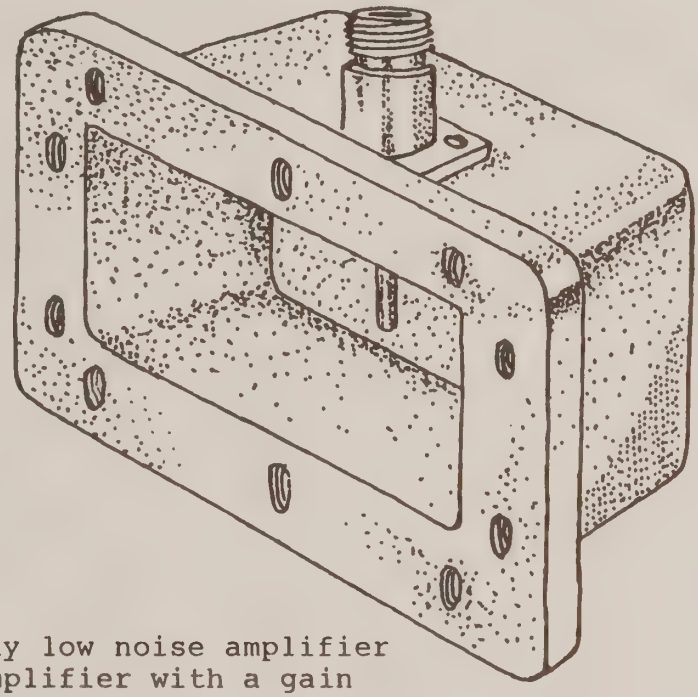
At $2675, the PSA-65A is a definite bargain. Even if you think that you don't need a spectrum analyzer, we're sure this one would prove you wrong. **R-E**

AVCOM® New Product Announcement

WCA-4A Waveguide to Coax Adapter

The WCA-4A Waveguide to Coax Adapter transforms signals in waveguide transmission line to coaxial line and vice versa. The adapter functions for signals in the 3.7 to 4.2 GHz range in either direction. Mounting is simple with standard 1/4 20 bolts and nuts, which are included. The WCA-4A is a versatile and useful accessory for every installer, dealer, and test bench.

FEATURES:
* Made in USA
* Cast aluminum construction
* Numerous possible applications



SPECIFICATIONS:

Frequency	3.7 - 4.2 GHz
Insertion Loss	0.2 dB
VSWR	1.25 (typical)
Weight	9 ounces
Dimensions	Height 2 3/4"
	Width 3 13/16"
	Length 2 3/4"
Connector	Type N (others available)
Mounting Holes	10 Clearance

APPLICATIONS:
Line Amplifier: Attach the WCA-4A to any low noise amplifier for an instant high-performance line amplifier with a gain equal to the LNA, at a lower cost than most commercial line amps.
Signal Distribution: Use with an LNA and power dividers for 3.7 - 4.2 GHz signal distribution in showrooms or for making extremely long feedline runs at exhibits, demonstrations, or installations.
Signal Input: Attach the WCA-4A to waveguide out-put type feedhorn for conventional method of inputting signals into or out of test equipment such as spectrum analyzers, signal generators or downconverters.
System Testing: Use with AVCOM's TISH-40 Terrestrial Interference Survey Horn and MSG-5 Microwave Signal Generator to direct signals into a TVRO Antenna for test purposes.
Quality Control: The WCA-4A is an excellent test bench component for LNA evaluation.
Many Others.....

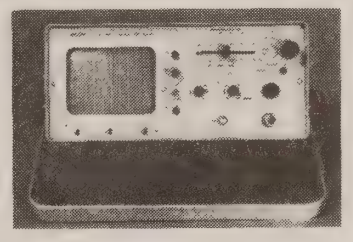
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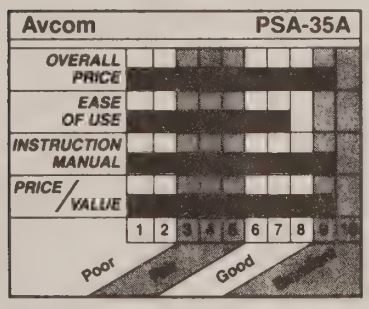
AVCOM PSA-35A Portable Spectrum Analyzer

An indespensible tool for TVRO installation and servicing



IF YOU THINK OF SPECTRUM ANALYZERS as instruments that cost tens of thousands of dollars and are at home on—and are hardly ever moved from—a laboratory test bench, you better think again! The TVRO industry has fueled many advances in microwave components. The same technology and components that have helped the cost of satellite receiving equipment to drop so dramatically during this decade has benefited test equipment for microwave frequencies as well. We recently had the opportunity to inspect one of the benefactors: the *PSA-35A* portable spectrum analyzer from Avcom of Virginia, Inc., (500 South Lake Blvd., Richmond,VA 23235).

A spectrum analyzer is a scanning radio receiver that displays the signals present in a given part of the RF spectrum. It can be an extremely valuable tool for a TVRO installer. Using it, a technician can greatly speed up the dish-aiming process and polarizer adjustment. He can measure the performance of LNA's and downconverters, troubleshoot cabling and connector problems, and even spot *T*errestrial *I*nterference (TI) problems. Before we look at how the analyzer can be put to work in practical applications, let's take a look at its general specifications and features.



The *PSA-35A* offers 5 low bands of coverage from less than 10 MHz to greater than 1500 MHz, and a single high band from 3.7 to 4.2 GHz. The low bands are configured as follows:

a) less than 10 MHz to 500 MHz
b) 270 MHz to 770 MHz
c) 400 to 900 MHz
d) 950 to 1450 MHz

The fifth low-frequency band can be preset by the user to cover any 500-MHz band between 300 MHz and 1500 MHz (or up to 1900 MHz on special order).

The *PSA-35A* offers two input connectors: The low band connector is a BNC type, and the high-band connector is an N type. Because it is a TVRO service tool, the

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connectors can supply (at the flick of a front-panel switch) +18 volts DC (Which is required by most LNA's and block downconverters).

Signals are displayed behind a 10 × 7 graticule. The horizontal (frequency) scale can be adjusted using the continuoulsly variable SCAN control from 1 MHz per division to 50 MHz per division. In other words, you could expand the entire display to show a 10 MHz bandpass, or compress it to show the signals in a 500 MHz bandpass—all the transponders on a given satellite, for example. The vertical (amplitude) scale can be either 10 dB per divsion or 2 dB per division.

Using the analyzer

A TVRO installation technician could use the *PSA-35AA* in a number of ways—even before the actual installation. The first step in any TVRO installation procedure is a *site survey*, which determines the suitability of a given site for installation. A clear view of the southern horizon is not the only factor determining site suitability; the site must also be free of interference from terrestrial microwave links. That's where the *PSA-35A* comes in. When used along with an auxiliary feedhorn that Avcom calls the TISH (*T*errestrial *I*nterference *S*urvey *H*orn), the spectrum analyzer can indicate the presence or absence of TI.

Knowing whether TI is present *before* a dish is installed can save an installer a lot of headaches and a lot of extra work. In many cases, a suitable site can be found not too far from the first, but with some tree, building, or other obstruction blocking the TI.

Once a site is found, and a dish and feedhorn are installed, a spectrum analyzer can again make the job easier. At a glance, the analyzer can show the signals in a given band and their strengths. It can make homing in on the Clarke belt a breeze. And because the spectrum analyzer is so sensitive, using it to aim the dish is much more reliable than using a receiver and a monitor. Small adjustments of the dish that would make little difference on the picture seen with a strong transponder would be seen quite dramatically on the display, especially when the unit is switched to an amplitude sensitivity of 2 dB per division. The result is better overall TVRO operation.

The spectrum analyzer again shows its strengths when it's time to align the polarizer. You can display the outputs of several transponders on the screen and watch the cross-polarized transponders null out.

The manual included with the *PSA-35A* is written directly for the TVRO installer. Its application section gives several excellent examples of how to use the instrument in TVRO installation and service. It also includes several pre-cut acetate sheets that can be slipped directly over the display so that the signal and switch settings can be traced and kept on record. It also includes a form that Avcom calls a SASAR (*S*pectrum *A*nalyzer *S*ystem *A*nalysis *R*eport) for recording all pertinent information of an installation. If problems develops in the future, a comparison of SASAR measurements could allow the serviceman to quickly solve the problem.

The *PSA-35A* is an excellent servicing tool. It has a suggested list price of $1965. If you are involved in TVRO service, you can expect to recoup the cost quickly. **R-E**

SATELLITE TV



BOB COOPER, JR.,
SATELLITE-TV EDITOR

Microwave test equipment

WHEN THE FIRST HOME SATELLITE DISH systems appeared in the marketplace late in 1979, they were priced at just under $4,000 (wholesale). Most people were astounded that so complex a system could be assembled for so small an amount of money. Competition and technological evolution have improved things to the point that today a system with similar (or improved) performance characteristics sells for as little as $350 (wholesale). However, it is not just the dish systems themselves that have benefited from the on-going evolution in electronics.

In fact, the growth of TVRO has fueled a number of innovations in the microwave area, but none is more dramatic than the innovations in microwave test equipment. And that new equipment surely must must frighten old-line builders of microwave test instruments such as Hewlett Packard. The spectrum analyzer is a case in point. High-performance spectrum analyzers have always cost an arm and a leg. The most important factors to consider include: maximum operating frequency, resolution, sensitivity, and stability.

The unit shown in Fig. 1 is a good example of a low-cost, high-performance spectrum analyzer. We'll discuss it in detail below, but for now let's consider some of the problems involved in setting up a TVRO system, and how a spectrum analyzer can help.

Installation

Installing a small-dish satellite-receiving system (whether for video, audio, or data communication) has changed little since 1979. First the components of the system must be brought together. Then the dish must be erected on its mount and outfitted with the necessary electronics. Last, the dish must be aimed at the desired satellite, which is located some 24,000 miles away.

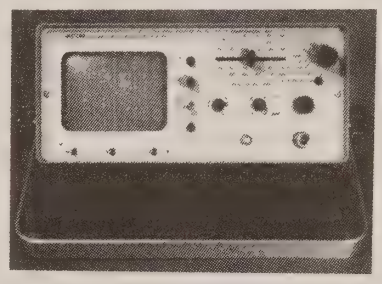


FIG. 1

The aiming process is complicated by the number of satellites now in operation, by those soon to be, and by the rapidly expanding use of the same frequency band (3,700 to 4,200 MHz) for point-to-point terrestrial communications. In short, there are many possibly interfering signal sources, and only one is right for a particular installation.

Of all of the instruments designed to measure the strength and quality of a microwave signal, none approaches the spectrum analyzer for either accuracy or spectral integrity. Unfortunately, however, until very recently the cost of a good microwave spectrum analyzer made those less-accurate instruments more attractive than they, on their own merits, deserved.

A breakthrough

The good news is that the same technology that made it possible for the price of a TVRO receiver to drop by a factor of 10 (or even 20) has now been applied to the spectrum analyzer. In fact, an entirely new generation of microwave test instruments is now available; many are priced at 10% or less of the cost of the older HP-style units. And they have been designed from the ground up to be portable, self-powered, field-usable instruments.

One portable spectrum analyzer is made by AVCOM of Virginia Inc., (500 South Lake Blvd., Richmond, VA 23235), a veteran of the satellite-TV field. The *PSA-35*, shown in Fig. 1, offers six bands of coverage as follows:

- Below 10 MHz to 770 MHz
- 270 MHz to 770 MHz
- 400 MHz to 900 MHz
- 950 MHz to 1450 MHz
- Any 500-MHz band between 300 and 1500 MHz
- 3,700 MHz to 4,200 MHz.

That combination of bands makes it possible for the installer to detect and display either a full 500-MHz-wide satellite downlink, or, with the assistance of the unit's controls, any span as narrow as 2 MHz within any of the covered bands.

The 3,700- to 4,200-MHz band covers the satellite downlink frequencies. A built-in low-noise amplifier can be coupled to the TVRO antenna of the system to be installed or to a separate horn antenna. In either case, the analyzer can be used to display both the desired signal and any interfering signals directly.

The other five bands cover all of the commonly found TVRO IF's (*I*ntermediate *F*requencies). That

allows the system installer to verify the performance of downconverter and LNB (*Low-Noise Block Downconverter*) units, to check cable losses and fittings, to measure distribution system parameters, and even to check for the correct operation of a cable-TV system.

What made it possible

Low-cost microwave test equipment has been feasible for several years. However, the specialized knowledge that designers of TVRO receivers had acquired was missing. In particular, flat mixers and flat sweep oscillators had to be developed using the same low-cost approach as TVRO receivers. Some exciting developments in YIG (*Ytrium-Iron-Garnet*) oscillator designs also helped pave the way for low-cost spectrum analyzers and other high-frequency test equipment.

For example, other generally-available test gear can provide: direct frequency readout of carriers to 4,200 MHz (accurate to 1 MHz) for under $1,000; accurate readout at 4,200 MHz of signal levels to within ±2 dB for under $500; and direction-finding interference-locating systems accurate to within 5 degrees for under $600. You can even purchase microwave signal generators capable of generating significant amounts of power modulated by color bars and an audio tone, or by your own video source (such as a tape deck or a video camera), for under $1,000. None of that equipment was practical, and a great deal of it was simply impossible, as little as two years ago.

The new microwave gear can be put to use in other bands as well. For example, Ku-band equipment (which operates in the 11- and 12-GHz bands) may be tested and aligned by simply connecting an LNB ahead of a 4,200-MHz instrument. That's a cost-effective solution to a potentially sticky problem, because an LNB can be obtained for under $200.

Other fields may also benefit from advances made in microwave test instrumentation. Virtually any electrical quantity can now be measured with a high degree of accuracy at frequencies as high as 4,200 MHz, and even higher.

So if you service or install high-frequency equipment of any sort, you should be grateful to the TVRO industry—advances made there will benefit all of us.

R-E

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•WIRELESS PRIMER Part 10

This is the tenth in a series of articles which are aimed at providing a basic understanding of wireless cable TV technical operation to those who have just entered the industry or those who are contemplating entering it as technicians, operators, or investors.

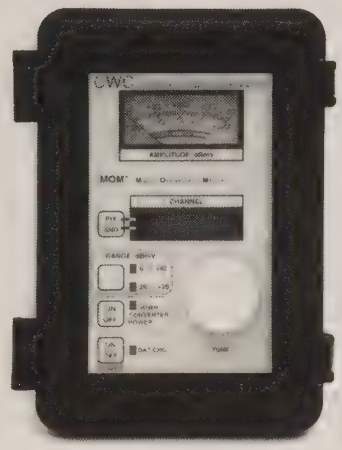
Site surveys

Emily & Glyn Bostick

Wireless technicians use test equipment for a variety of purposes. When equipment malfunctions, test equipment is used to diagnose the problem. Adjustments are often necessary after repairs. The same equipment can also be used for doing on-site surveys. The site survey involves simply going to a location and setting up the portable equipment necessary to measure signal levels at the location.

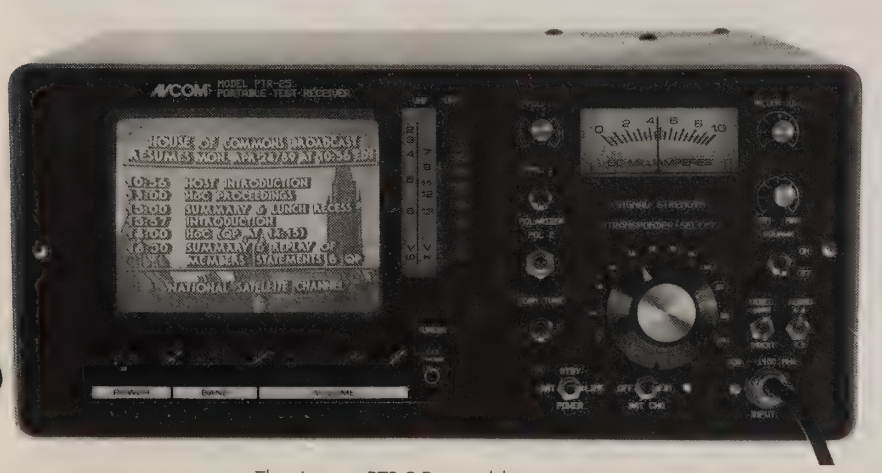
Types of site surveys

There are basically four types of site surveys. They include: (1) coverage surveys, (2) interference surveys, (3) blockage or isolation surveys, and (4) installation or "proofing" surveys. Surveys are sometimes done to make coverage maps. This involves going to a large number of locations at various azimuths and distances from the transmitter and simply measuring signal levels. The levels are then plotted onto a map overlay. Coverage maps confirm for engineers and technicians that the antenna and transmission line system is operating as designed. In addition, they allow operators to determine the accuracy of computer simulations. Finally, coverage maps allow the wireless operator to know the station's actual coverage pattern for installation, marketing, and planning purposes.



CWC's "MOM signal strength meter.

When an MMDS receiver experiences terrestrial interference, it may be necessary to identify the frequency and source of the problem. Interference surveys involve taking certain key measurements at the problem location. These measurements include identification of the frequency, level, polarization, and azimuth of the interference. These key variables can then be used by an interference analyst along with information from a frequency coordinator to solve the problem.



The Avcom PTR-25 portable test receiver.

Blockage or isolation surveys involve similar measurements in poor reception areas. Wireless relays can be used to provide service in poor reception areas. However, the FCC requires an isolation of at least 60 dB between the blocked and unblocked areas. To determine whether this degree of isolation is present, measurements must be done in the blocked and unblocked areas. Isolation surveys are also done before setting up a wireless system to determine whether signals are present from nearby systems in the prospective service area.

Table 1

Test & diagnostic equipment

1. Portable Spectrum Analyzer & Carrying Case
2. MMDS Operator's Signal Meter & Carrying Case
3. Portable Test Receiver & Carrying Case
4. LNBY (Yagi with Integrated LNB) Antenna & Mounting Hardware
5. Standard Gain Feed Horn with LNB & Mounting Hardware
6. Antenna (Camera) Tripod
7. CRT Camera with Film, Case, Accessories
8. RG-6 Coaxial Cables (Long) with Type F Connectors
9. RG-59/U Coaxial Jumper Cables with Type F Connectors
10. Attenuation Pads (1, 2, 3, 5, & 10 dB @ 75 ohm)
11. Magnetic Compass
12. Angle Finder
13. Inclinometer
14. Plastic CRT Overlays with Markers
15. Signal & Power Level Conversion Table
16. Scientific Hand Calculator
17. Clip Board with Paper, Pens, Ruler, Templates, & Protractor
18. Linear Graph Paper
19. Polar Plot Graph Paper
20. Telescoping Mast & Base with Hardware
21. Weatherproof loose leaf book for equipment manuals & maps

Installation or "proofing" surveys are done before setting up a subscriber system. They sometimes take as little as ten minutes to do and are done primarily to identify customer sites which are capable of receiving wireless signals. More extensive installation surveys are done before construction of a relay station. The installation survey basically involves verifying the presence of sufficient usable signal at a prospective site. Installation surveys also allow designers to know the gain of the antennas and amplifiers needed at the location.

Equipment

All of these site surveys require certain kinds test equipment. The technician must measure the frequency and level of MMDS signals. Frequently this involves making calibrated measurements of signal levels. The technician may also need to determine the polarization of the signals. She or he may want to look at a graph of the entire MMDS spectrum either to identify interference sources or to see the channel levels in relation to each other. Finally, the technician must be able to actually look at the television picture being received. Merely measuring certain variables may not be enough to tell the technician what subscribers will see when they turn on their sets. Table 1 lists the equipment and accessories typically needed for doing most site surveys.

Figure 1 illustrates a typical test set-up. By injecting a signal of known amplitude into the test set-up and by knowing the gains of the antenna and LNB being used, it is possible to calibrate the equipment. Measurements can then be referenced in decibels (dB) to a specific signal level. Spectrum analyzers designed for field measurements typically have internal circuitry for calibrating readings to 0, - 20, or - 40 dBm. However, for some purposes uncalibrated measurements are sufficient to demonstrate that usable signal is present at the location of interest. Thus, the equipment shown can be used in many different arrangements for numerous purposes.

A 35 mm camera or a Polaroid CRT camera can be used to easily record a large number of measurements from a spectrum analyzer. However, great care must be taken to label photos recording the scales shown on the screen; other-

Table 2

Photo record

Customer: _____

Site Title: _____

Location: _____

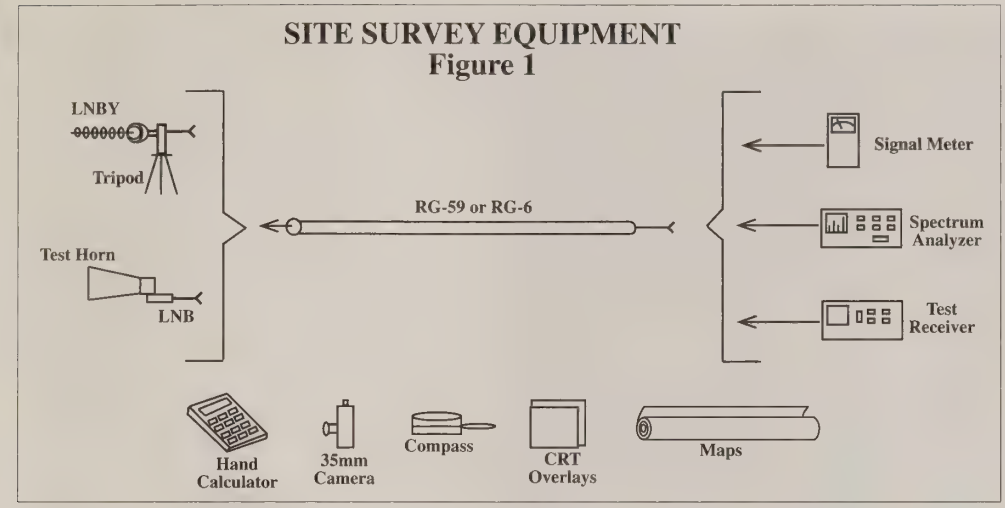
Latitude: ___ o ___ ' __.__" Longitude: ___ o ___ ' __.__"

Antenna Gain: ____ dB LNA/LNB Gain: ____ dB BDC Gain: ____dB

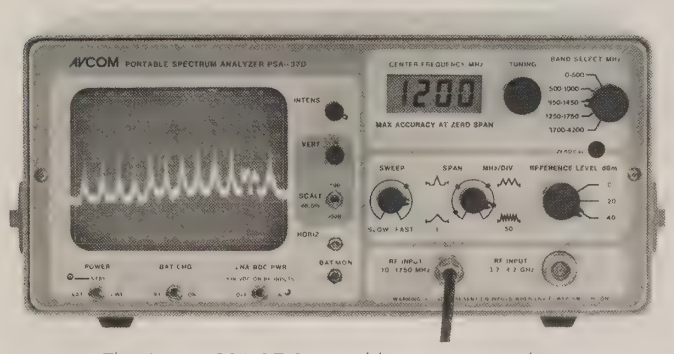
Reference Level: _____ dBm DATE: _____ TIME: _____ AM/PM

Technician: _____ Page __ of __

Photo Negative Number	— Scale Settings — Frequency (___ Hz)	Level (dB)	Remarks / Notes



wise the photos are completely useless. Table 2 shows a form which can be utilized for this purpose. CRT overlays are also available for recording information by tracing signal wave forms from the CRT of an analyzer. Table 3 illustrates the information usually recorded during an on-site survey. A portable telescoping antenna mast like that sold by Radio Shack (Part #15-5065 or 15-5067) can be very useful for surveying potential installation locations. MMDS signals cast shadows. The blockage causing the shadow might be miles away. Raising a wireless antenna just a few feet can sometimes result in dramatic changes in signal levels. Some wireless operators use hydraulically operated telescoping masts mounted on pick-up trucks for installation surveys. The Mighty Mount™ portable mast system represents a lower cost alternative to hydraulic masts which can even be left in place if necessary.



The Avcom PSA-37 D portable spectrum analyzer.

Many site surveys require some degree of competency in working with topographical maps. Most people with any kind of military background have received basic instruction in the use of maps and compasses. An inexpensive instruction aid for those who don't have such a background is the Department of the Army's Field Manual FM 21-26 Map Reading. Topographical maps are made and updated by the U.S. Geological Survey.

Nearly all of the portable test equipment designed for site surveys operates on rechargeable batteries. Portable field analyzers, signal meters, and test receivers all have internal provisions for injecting DC onto the test lead for powering an LNA or LNB. The azimuth of an incoming signal can be determined simply by swinging the antenna or test horn around 360-degrees until the maximum signal level on the equipment test is found. The magnetic azimuth of the antenna can then be measured using a compass.1 Polarization is found in the same way by rotating the feed horn between horizontal and vertical for maximum reading.

A spectrum analyzer can be used to measure both the frequency and the level of signals. Signal meters typically measure the signal level of either video or sound carriers. Frequencies are read out on an LED display. Signal levels can be converted to field *strengths* using a conversion formula. Attenuation pads are used to reduce extremely strong signal levels. This usually occurs when working with interference problems

Table 3

On-site measurement table

Customer: _____

Site Title: _____

Location: _____

Latitude: ___° ___' __.__" Longitude: ___° ___' __.__"

Antenna Gain: ___ dB LNA/LNB Gain: ___ dB BDC Gain: ___dB

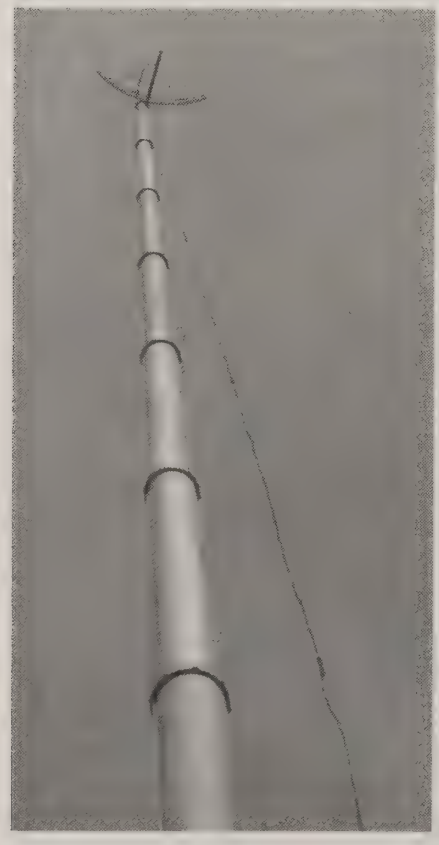
Reference Level: _____ dBm DATE: _____ TIME: _____ AM/PM

Technician: _____ Page __ of __

Video Channel or Audio Number	Frequency (GHz)	Signal Level (dBmV)	Magnetic Polarization (V/H)	Azimuth (degrees)



Typical hydraulically operated site survey truck with telescoping mast.


When the mast is extended, it can be raised 50 feet from its base

involving nearby transmitters. Once actual levels at the site have been determined, it is then a relatively simple task of addition or subtraction to calculate the additional gain needed (if any) from the antenna and LNB combination in order to receive usable signals.

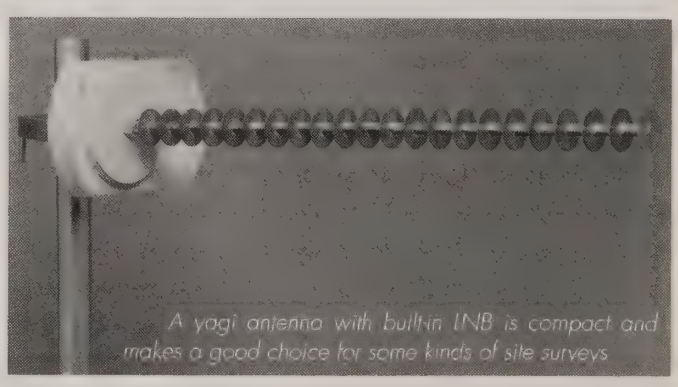
The price of laboratory grade microwave test equipment is astronomical. For example, laboratory quality spectrum analyzers start at around $40,000. Such equipment is necessary for transmitter adjustments and high grade proof of performance tests done for submission to the FCC. But use of such high grade equipment for many other types of surveys is inappropriate for a number of reasons.

Serious damage to extremely sensitive equipment can occur in the field. Lab equipment requires an AC power source which may not be present in the field. Further, the equipment is bulky and unsuitable for mobile applications. Finally, the accuracy and stability of lab equipment is influenced by the length of time that the equipment has been running. It often takes a high quality spectrum analyzer at least half an hour for the equipment to stabilize. The high accuracy of such equipment would probably be lost under most field conditions.

Relatively inexpensive portable test equipment suitable for many kinds of site surveys and for diagnostic purposes is available. Typically portable spectrum analyzers start at around $2,500. The manufacturers list gives sources for various types of test equipment and accessories. Nearly all of this equipment can also be used for working with CATV, MATV, and TVRO systems.

Consultants and contractors

There are a number of consultants in business who do various types of site surveys on a contractual basis. Whether to utilize a contractor or train staff to do the job depends a lot upon the type of survey needed. For example, measurements done for submission to the FCC should be done by an independent frequency coordinator with precision equipment. But hiring a frequency coordinator to do installation


A yagi antenna with built-in LNB is compact and makes a good choice for some kinds of site surveys

surveys is unnecessary and far too expensive. There are, however, consultants who do installations on a contractual basis. Thus, wireless operators should evaluate their options in relation to their needs. ◆

Next time

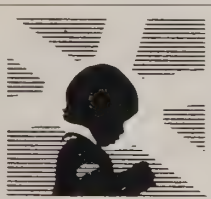
Part 11 will look at an actual wireless headend.

Footnote

[1]Nearly all typographical maps are keyed to three different grid systems: (1) magnetic north, (2) true (Geographic) north and (3) grid north. Geographic north is based on the earth's axis which points toward Polaris. Grid north is usually between the other two.

About the authors

Emily and Glyn Bostick are president and executive vice-president of the Communications and Energy Corporation specializing in the manufacture and export of RF/MW filters, antennas, and other passive transmission line components for TV related facilities such as CATV, MMDS, TVRO, LPTV, and Mobile Radio. Glyn Bostick is a graduate of Yale (1947) with some forty-seven years of experience designing components for a wide variety of firms in the radio electronics industry including General Electric, Western Electric, and Grumman. He co-authored the book ASTI: The Avoidance/Suppression Approach To Eliminating Terrestrial Interference at TVRO Earth Stations (East Syracuse, New York: Microfilco Press, 1983).



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Fax: (504) 524-1010

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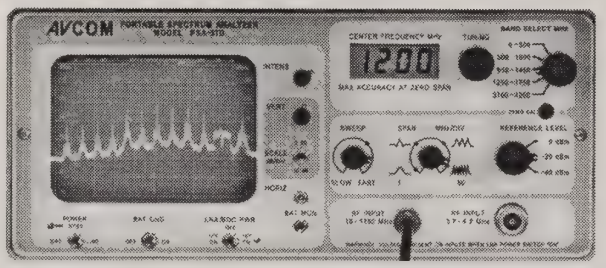
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Legend:
{1} Attenuation pads & accessories
{2} Feed horn antennas
{3} LNAs, LNBs, & block converters
{4} LNBY (Yagi) antennas
{5} MMDS operator's meters
{6} Portable test receivers
{7} Spectrum analyzers
{8} Telescoping/portable antenna masts
{9} Transport cases
{10} Government documents

AVCOM®

Cost Effective Test Equipment for Installing and Servicing Wireless and Cable Communication Systems

Portable Spectrum Analyzer
PSA-37D $2475



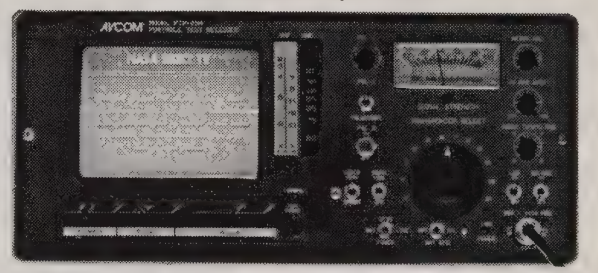
The PSA-37D Portable Spectrum Analyzer is AVCOM's answer to all your downlink installation, service, and maintenance problems. Frequency coverage is from 10 to over 1750 MHz, and from 3.7 to 4.2 GHz in 5 bands. Frequency readout is shown in MHz on a four digit LCD front panel display. The digital readout allows fast, easy and accurate operation of your AVCOM PSA-37D Portable Spectrum Analyzer.

The digital readout allows you to identify and resolve terrestrial interference problems by displaying offending signals and their frequencies.

The PSA-37D has a built in DC block with +18 VDC for powering LNA's and BDC's, calibrated signal strength amplitude display and internal battery with charger. Selectable vertical sensitivity of either 2 dB or 10 dB/DIV is standard.

All areas of the satellite communication industry from Dealers, Installers, Repair Centers, Maintenance Contractors, and Manufacturers to single and multiple System Owners will find AVCOM's PSA-37D to be an indispensable instrument for rapid testing and alignment of satellite equipment.

Portable Test Receiver
PTR-25A $1395

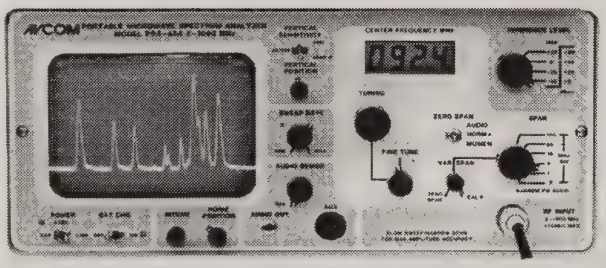


AVCOM's Portable Test Receiver, the PTR-25A, sets a new standard of performance for a comprehensive battery operated satellite receiver. The built-in 4.5" B & W TV offers reduced power consumption and longer battery life than comparable color units. Picture definition and "sparklie" resolution is excellent with the B & W display. A full range of outputs are available for observing the 70 MHz IF signal including terrestrial interference, if any, on AVCOM's comprehensive line of spectrum analyzers.

A large, easy to read signal strength meter is located on the front panel and an audible signal strength indicator function is provided for dish peaking without any need to monitor the meter or display. As the signal nears maximum strength the pitch of the audible tone rises and allows the dish to be peaked to a fraction of a dB.

Very attractive styling (that coordinates with the AVCOM PSA-37D Spectrum Analyzer) and rugged packaging make the PTR-25A Portable Test Receiver an important and necessary addition to the Installer/Dearler's test equipment. An attractive and functional Cordura carrying case is available.

Portable Spectrum Analyzer
PSA-65A $2855



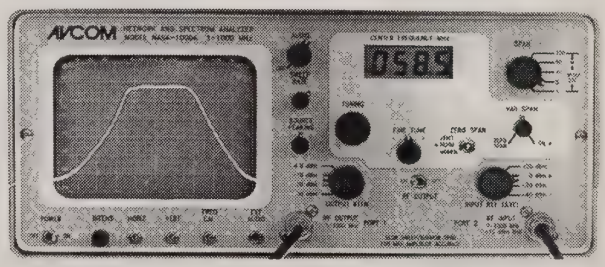
AVCOM's PSA-65A Portable Microwave Spectrum Analyzer covers a frequency range from less than 2 MHz to 1000 MHz. The broad frequency coverage and high sensitivity of the PSA-65A make it ideal wherever a low cost, compact spectrum analyzer is needed. The lightweight, battery or line operated PSA-65A Portable Spectrum Analyzer from AVCOM is the perfect instrument for field testing of RF systems, classroom instruction, satellite system alignment, electronic countermeasures, cable TV maintenance, cellular and production use.

The small size, lightweight and low cost of the PSA-65A will enable companies to issue spectrum analyzers to their technical staff when more expensive units could not be justified. The increased productivity and diagnostic power of employees equipped with a PSA-65A will quickly offset the low cost.

A unique zero span function switch allows instant monitoring of transmissions as soon as the "spike" is tuned to the center of the display.

A full line of accessories for the PSA-65A is available from AVCOM.

Network And Spectrum Analyzer
NSA-1000A $3875



The NSA-1000A is a powerful and versatile Integrated Network And Spectrum Analyzer. It can be used as a stand alone 1-1000 MHz spectrum analyzer with an internal FM demodulator or used as a network analyzer by activating its built in tracking generator.

The NSA-1000A's front panel is functionally separated into 3 areas; the display, an RF source and a swept receiver (spectrum analyzer). The frequencies of the RF source and of the swept receiver track and the response of an RF network inserted between the RF source and receiver is displayed on a CRT. Step attenuators in the source and receiver facilitate measurement of lossy networks (i.e. filters, attenuators) and networks with gain (i.e. amplifiers).

The NSA-1000A is ideal for receiver and transmitter alignment and troubleshooting, LAN analysis, cable head end level balancing, satellite receiver alignment and signal demodulation (with optional demodulator). Other applications include classroom instruction, production testing, cable TV maintenance, amateur radio, and surveillance and countermeasures.

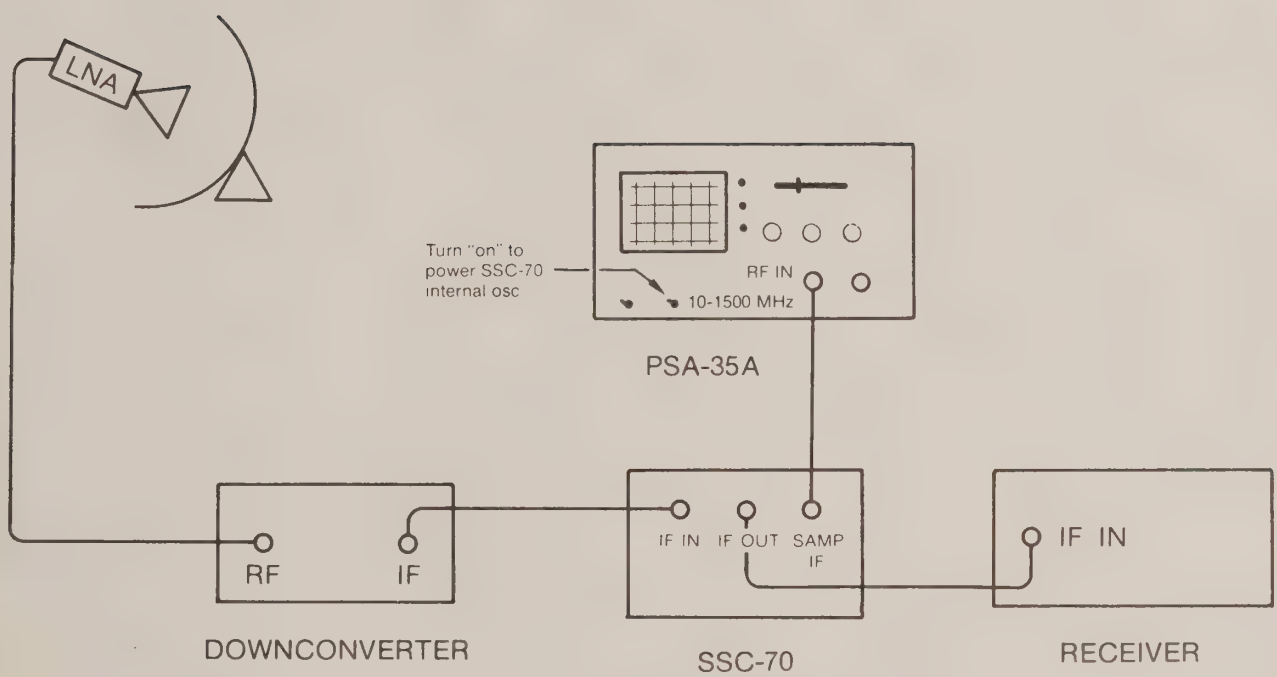
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SSC-70 APPLICATION

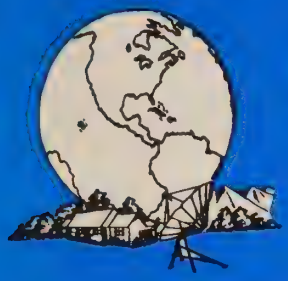


Typical connection for SSC-70 using Avcom's PSA-35A

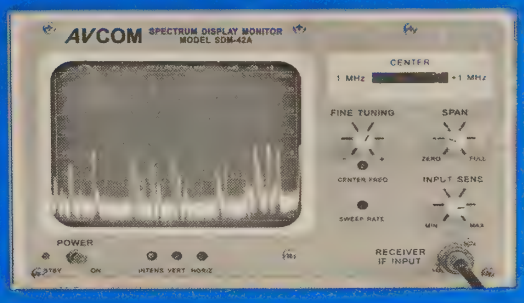
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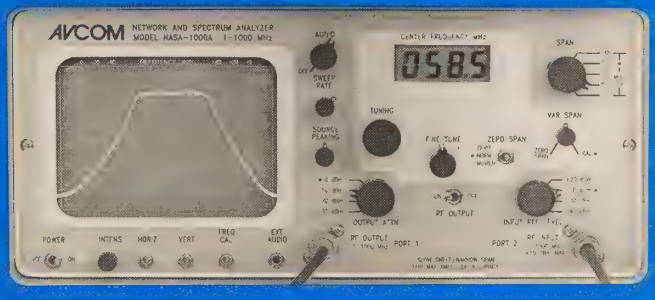
1995 PRODUCT CATALOG

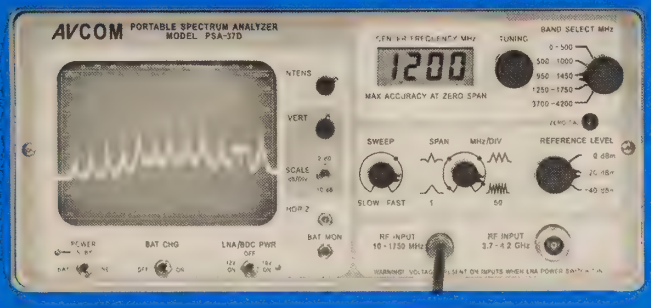


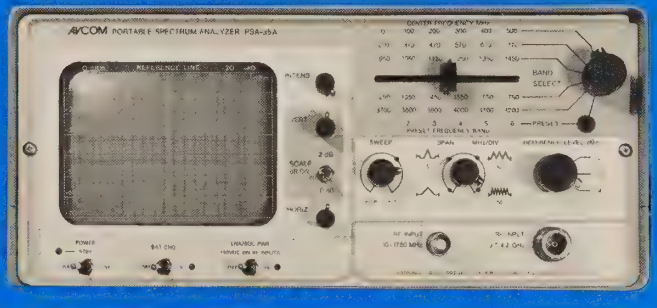
BRINGING HIGH TECHNOLOGY DOWN TO EARTH



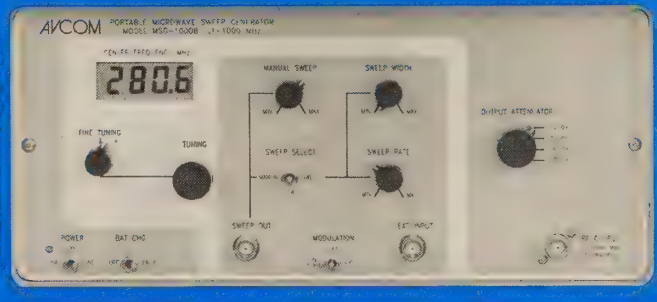














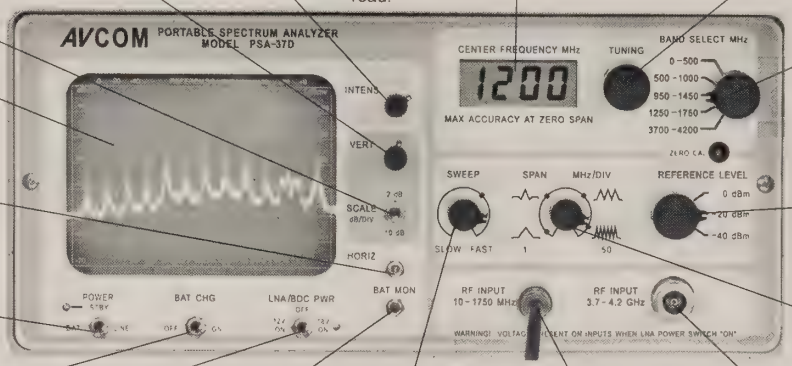


Network Analyzers, Spectrum Analyzers, Sweep Generators, Satellite Receivers, and Microwave Components

500 SOUTHLAKE BOULEVARD, RICHMOND, VIRGINIA 23236, U.S.A.
TELEPHONE 804-794-2500 - FAX 804-794-8284

ALL AVCOM EQUIPMENT MADE IN THE U.S.A.

PSA-37D Portable Spectrum Analyzer



VERT is used to position the display on the screen.

INTENSITY controls the brightness of the display.

NEW FEATURE

CENTER FREQUENCY is a 4 digit LCD display that allows you to accurately read the frequency in MHz of a signal centered on the display. New circuitry makes it even more stable and easier to read.

CENTER FREQUENCY TUNING tunes the PSA-37D through the selected band and centers signals of interest on the display while their frequency is read on the CENTER FREQUENCY READOUT.

SCALE is used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV.

Large bright screen for outdoor and indoor use. Scale calibrated in 10 dB or 2 dB steps for accurate, repeatable measurements . 65 dB dynamic range.

BAND SELECT controls input frequency range to accomodate IF, LNB and LNA output frequencies. Frequency ranges are 0 to 500 MHz, 500 to 1000 MHz, 950 to 1450 MHz, 1250 to 1750 MHz and 3.7 to 4.2 GHz.

NEW FEATURE

HORIZ is used to position the display on screen. New factory set recessed control makes set up easier.

POWER switch has 3 positions for Battery Operation, Standby and AC Line Operation.

REFERENCE LEVEL controls the sensitivity of the display to allow signals as weak as -95 dBm as well as strong signals to be displayed.

SPAN determines the width of the spectrum being displayed and can be adjusted to display over 500 MHz or less than one transponder in a sweep.

BAT CHG switch recharges PSA-37D to at least 80% capacity in about 6 hours.

NEW FEATURE

Selectable 12 or 18 VDC LNA/BDC power for feedline powering of system components.

NEW FEATURE

When BAT MON is depressed, the voltage of the internal battery pack is displayed on the LCD.

SWEEP controls rate of analyzer frequency sweep and the speed of the trace across the display.

10-1750 MHz RF INPUT is used for observing LNB, IF, MATV and other signals from 10 to over 1750 MHz. Will provide +18 VDC to power system components.

3.7-4.2 GHz RF INPUT is used when observing the output directly from an LNA. Feedline losses can be measured. Can power an LNA with +18 VDC.

FEATURES

* Frequency coverage from 10 to 1750 MHz and from 3.7 to 4.2 GHz, in 5 bands.
* Accurate 4 digit LCD frequency readout.
* Accurately measures wideband signals commonly used in the satellite communications and CATV industries.
* Lightweight, portable, battery or line operated - perfect for field test situations.
* Ku and C band compatible.
* Built in DC block and power for LNA's and LNB's.
* 220-240 volt models available.

PSA-37D PORTABLE SPECTRUM ANALYZER

The PSA-37D Portable Spectrum Analyzer is AVCOM's answer to all your downlink installation, service, and maintenance problems. Frequency coverage is from 10 to over 1750 MHz, and from 3.7 to 4.2 GHz in 5 bands. Frequency readout is shown in MHz on a four digit LCD front panel display. The NEW digital readout allows fast, easy and accurate operation of your AVCOM PSA-37D Portable Spectrum Analyzer.

The digital readout allows you to identify and resolve terrestrial interference problems quickly and precisely by displaying offending signals and their frequencies.

The PSA-37D has a built in DC block with +18 VDC for powering LNA's and BDC's, calibrated signal strength amplitude display and internal battery with charger. Selectable vertical sensitivity of either 2 dB or 10 dB/DIV is standard. The portable battery or line operated PSA-37D with digital frequency readout is ideal for field test situations and is the perfect instrument for the critical alignment and tracking measurements necessary for maximum signal reception.

DBS/DSS DISH ALIGNMENT A SNAP!!!

DSS signals from the DIRECTV-HC5 spacecraft can be seen with AVCOM's PSA-37D Portable Spectrum Analyzer. Normal DSS alignments, such as roof, wall or backyard, are quickly accomplished in seconds with the PSA-37D because the DSS receiver and TV monitor do not have to be at the DSS antenna. Those attempting more creative DSS dish installations (inside buildings, looking through sparse foliage, using smaller antennas than the 18" offset supplied, or concealed installations) where the signal obtained is not optimum or there is uncertainty where to point the dish, will likely find it difficult to use the receiver's built-in alignment program because it may not have been intended for such applications. If the installer has an AVCOM PSA-37D spectrum analyzer the signal can be very quickly located and measured even though it is below the receiver's signal strength requirement and steps can be taken to improve the signal by larger antenna or relocation. What appears to be an impossible installation may become doable, and hours can be turned into seconds with the use of an AVCOM PSA-37D portable spectrum analyzer and site survey horn. Contact AVCOM for a copy of the DSS Application Note.

All areas of the satellite communication industry from Dealers, Installers, Repair Centers, Maintenance Contractors, and Manufacturers to single and multiple System Owners will find AVCOM's PSA-37D to be an indispensable instrument for rapid testing and alignment of satellite equipment.

TECHNICAL SPECIFICATIONS

FREQUENCY COVERAGE

Low Band: a) 10 to 50 MHz
b) 500 to 1000 MHz
c) 950 to 1450 MHz
d) 1250 to 1750 MHz

High Band: 3.7 to 4.2 GHz

INPUT CONNECTORS

Low Band: BNC (type F to BNC adapter included)
High Band: type N

INPUT CONNECTORS DC BLOCK CAPABILITY

Both input connectors are DC blocked and provision is made for insertion of +18 VDC into connector by front panel switch.

CIRCUITRY

Most on pluggable PC boards for rapid and easy service.

FREQUENCY DISPLAY/ACCURACY

4 digit LCD frequency readout / accuracy±4 MHz nominal, at zero span.

REFERENCE LEVELS

0, -20, and -40dBm / +49, +29, and +9 dBmv

SENSITIVITY/DYNAMIC RANGE

Selectable 2 dB/DIV or 10 dB/DIV
Dynamic range +60 dB

AMPLITUDE ACCURACY

±2 dB typical per band

RESOLUTION BANDWIDTH

300 KHz

CALIBRATION

Internal calibration (factory set)

SPAN

Over 500 MHz (50 MHz/DIV) to less than 1 MHz/DIV

WEIGHT

17 pounds/7.72 Kg

DIMENSIONS

14 1/2" W x 5 1/2" H x 13 1/2" D
37 cm W x 14 cm H x 34 cm D

CONSTRUCTION

Attractive and durable epoxy painted heavy gauge aluminum chassis and cover, with carrying handle and bail, which also serve as feet to stand the unit on end for easy viewing and operation in the field.

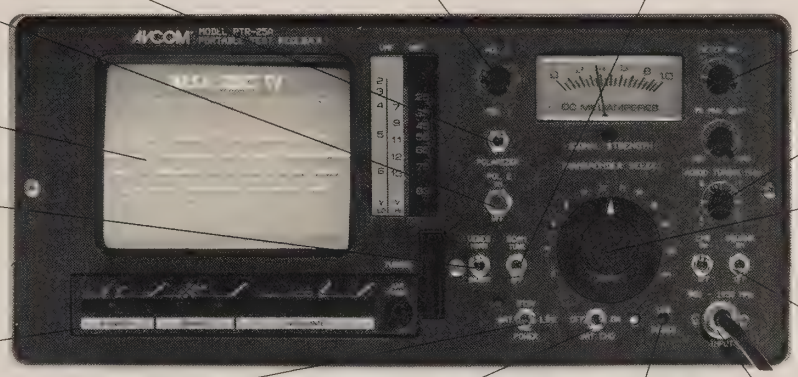
POWER REQUIREMENTS

115 VAC, 60 Hz, 65 watts - internal rechargeable gel cel battery - 220/240 volt model available.

ACCESSORIES

Numerous accessories are available, refer to accessories specification sheet.

PTR-25A Portable Test Receiver



AVCOM's Portable Test Receiver, the PTR-25A, sets a new standard of performance for a comprehensive battery operated satellite receiver. The built-in 4.5" B & W TV offers reduced power consumption and longer battery life than comparable color units. Picture definition and "sparklie" resolution is excellent with the B & W display. A full range of outputs are available for observing the 70 MHz IF signal including terrestrial interference, if any, on AVCOM's comprehensive line of spectrum analyzers.

A large, easy to read signal strength meter is located on the front panel and an audible signal strength indicator function is provided for dish peaking without any need to monitor the meter or display. As the signal nears maximum strength the pitch of the audible tone rises and allows the dish to be peaked to a fraction of a dB.

Very attractive styling (that coordinates with the AVCOM PSA-37D Spectrum Analyzer) and rugged packaging make the PTR-25A Portable Test Receiver an important and necessary addition to the Installer/Dealer's test equipment. An attractive and functional Cordura carrying case is available.

FEATURES

*Portable - Battery Operated
*Audible and Visual Signal Strength Indicators
*Internal Recharging Circuitry
*Extended Battery Life with Fast Recharge Capability
*Polarotor and Polarizer Controls
*IF Output for Spectrum Analyzer

SPECIFICATIONS

RF INPUT	
Input Level	-70 dBm to -25 dBm
Frequency	950 - 1450 MHz
Impedance	75 Ohms
Power Gain	18 dB Typical
Noise Figure	-12 dB Typical
Image Rejection	35 dB Typical
Connector Type	Type F
AGC	Auto
IF	
Automatic Gain Control	Greater than 25 dB Dynamic Range
Frequency	70 MHz
Bandwidth	30 MHz
VIDEO	
Impedance	75 Ω
Return Loss	>25 dB
Polarity	Switch Selectable, Black to White, Normal or Inverted
Clamping	Fully Active, >40 dB
Output Level	1 Volt Peak to Peak, adjustable
De-emphasis	Standard NTSC
AUDIO	
The PTR-25A incorporates a tunable audio demodulator.	
Frequency	5.0-8.0 MHz
Frequency Response	30 Hz to 15 KHz +1 dB
De-emphasis	75 Microsecond
Output Level	.7 Volt Peak to Peak
Harmonic Distortion	<1.8% Specifications
PHYSICAL	
Dimensions	14.5"W x 5.5"H x 13.5"D
Weight	17 lbs. / 7.72 kg
Power Requirements	100 to 130 VAC,60Hz, 45 Watts or Internal Rechargeable Batteries
Operating Temperature	5 to 40 C

AVCOM PSA-35A
PORTABLE SPECTRUM ANALYZER

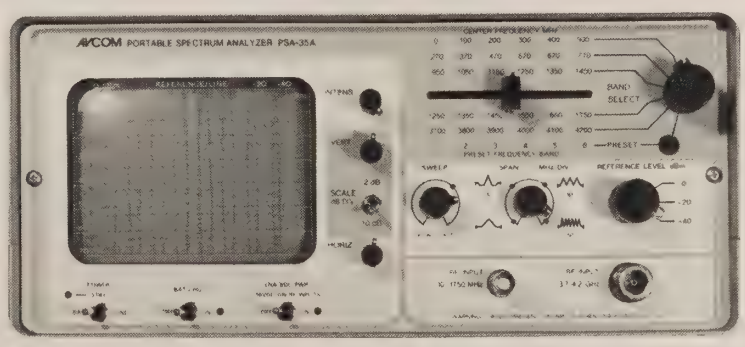
* Frequency Coverage 10-1750 MHz 3.7-4.2 GHz
* Basic enough to begin with - sophisticated enough to grow with. Ku and C band compatible.
* Lightweight, portable, battery operated - ideal for field test situations.
* Accurately measures wideband signals commonly used in the satellite communications industry.
* Built-in DC Block and Power for LNA's and LNB's.

Trouble-shoot system problems by observing output signals from LNA's, BDC's, Line Amplifiers and Splitters, and other RF signals components. Measure block system signal balance.

Identify and resolve terrestrial interference problems quickly and precisely by displaying offending signals on the PSA-35A. Customers can be shown the nature of TI problems for clearer understanding.

Measure and document satellite communication system performance after installation or service. Customer should be given a copy of results per AVCOM's SASAR (Spectrum Analyzer System Analysis Report) to insure customer confidence and satisfaction.

Progressive Satellite Communication Dealers, Repair Centers, and Manufacturers will find AVCOM's PSA-35A Spectrum Analyzer to be an indispensable instrument for rapid testing and alignment of satellite equipment. Problems that might otherwise take hours, even days to resolve, can be identified and corrected in minutes, saving time and money, while reinforcing customer good will. An AVCOM Spectrum Analyzer will pay for itself quickly.



AVCOM PSA-35A SPECIFICATIONS

FREQUENCY COVERAGE
Low Band: a) 10 to 50 MHz
b) 500 to 1000 MHz
c) 950 to 1450 MHz
d) 1250 to 1750 MHz
High Band: 3.7to 4.2 GHz

INPUT CONNECTORS
Low Band: BNC (type F to BNC adapter included)
High Band: type N

INPUT DC BLOCK CAPABILITY
Both input connectors are DC blocked and provision is made for insertion of +18 VDC into connector by front panel switch.

REFERENCE LEVELS
0, -20, and -40dBm/+49, +29, and +9 dBmv

SENSITIVITY/DYNAMIC RANGE
Selectable 2 dB/DIV or 10 dB/DIV/Dynamic range +60 dB

AMPLITUDE ACCURACY
+2 dB typical per band

RESOLUTION BANDWIDTH
300 KHz

CALIBRATION
Internal calibration (factory set)

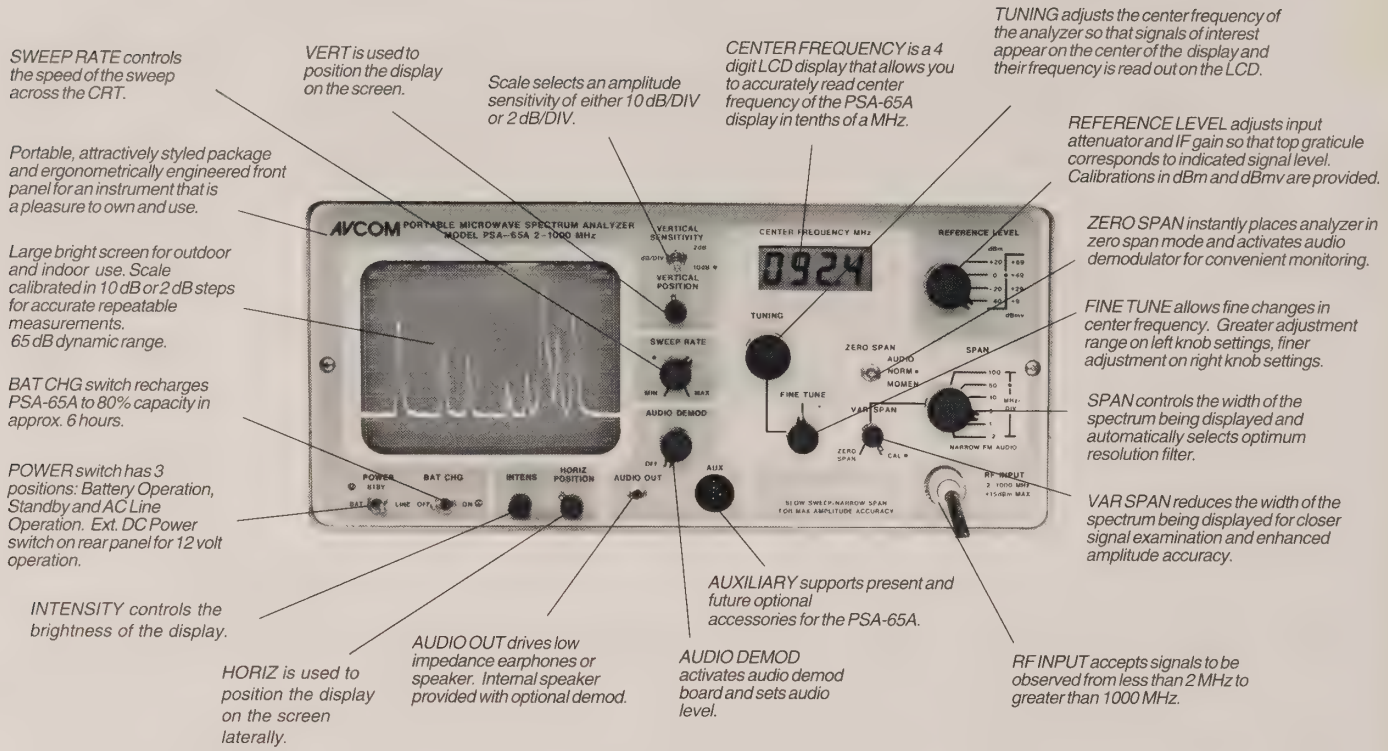
SPAN
Over 500 MHz (50MHz/DIV) to less than 1 MHz/DIV

WEIGHT
17 pounds/7.72 Kg

DIMENSIONS
14 1/2 W x 5 1/2" H x 13 1/2" D
37 cm W x 14 cm H x 34 cm D

POWER REQUIREMENTS
115 VAC, 60 Hz, 65 watts - internal rechargeable gel cel battery - 220/240 volt model available.

PSA-65A Portable Spectrum Analyzer



The Spectrum Analyzer Designed For Professionals By Professionals.

FEATURES:
*Battery or Line Operated
*Internal Battery Charger
*Digital Frequency Display of Center Sweep
*Frequency Accurate to .1 MHz at 0 Span
*2 MHz to 1000 MHz in One Sweep
*-95 dBm in Sensitivity
*Lightweight - Portable
*Functional, Ergonomically Designed Front Panel
*Rugged, Attractive Styling
*Affordably Priced
*Made in U.S.A.

AVCOM's PSA-65A Portable Microwave Spectrum Analyzer covers a frequency range from less than 2 MHz to 1000 MHz. The broad frequency coverage and high sensitivity of the PSA-65A make it ideal wherever a low cost, compact spectrum analyzer is needed. The lightweight, battery or line operated PSA-65A Portable Spectrum Analyzer from AVCOM is the perfect instrument for field testing of RF systems, classroom instruction, satellite system alignment, electronic countermeasures, cable TV maintenance, cellular and production use.

The small size, lightweight and low cost of the PSA-65A will enable companies to issue spectrum analyzers to their technical staff when more expensive units could not be justified. The increased productivity and diagnostic power of employees equipped with a PSA-65A will quickly offset the low cost.

AVCOM's PSA-65A can be ordered for operation on 110 or 220 VAC as well as the standard external 12 VDC and internal batteries.

A unique zero span function switch allows instant monitoring of transmissions as soon as the "spike" is tuned to the center of the display.

A full line of accessories for the PSA-65A is available from AVCOM.

INTERNAL PSA-65A OPTIONS:

10KHZ RESOLUTION BANDWIDTH FILTER for the .2 MHz/DIV span that extends lower frequency range to approximately 200 KHz.

FM AUDIO DEMODULATOR allows the PSA-65A to monitor transmissions after they have been observed on the display. This option is particularly useful for locating electronic listening devices.

AM DETECTOR gives the operator the capability to "hear" the vertical deflection of the CRT trace. It was originally designed for utility companies to detect RF leaks.

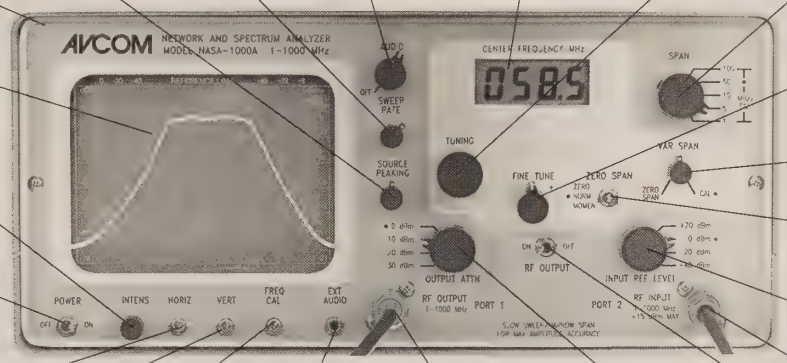
OSCILLOSCOPE INTERFACE outputs the CRT display of the PSA-65A to an oscilloscope.

SPECIFICATIONS

FREQUENCY COVERAGE
2 MHz to 1000 MHz in one sweep.
REFERENCE LEVELS
+20, 0, -20, -40dBm/+69, +49, +29, +9 dBmv
INPUT CONNECTOR
Type BNC (BNC to F adapter included)
Type N (optional)
DISPLAY
10 horizontal graticule Divisions (frequency) x 7 vertical graticule Divisions (amplitude). Each vertical Division equals 10 dB or 2 dB.
RESOLUTION BANDWIDTH
Automatically selectable by Span Control.
a) 3 MHz Res B.W. (set span at 100 MHz/Div)
b) 1 MHz Res B.W. (set span at 50 MHz/Div)
c) 300 KHz Res B.W. (set span at 10 MHz/Div)
d) 150 KHz Res B.W. (set span at 5 MHz/Div)
e) 75 KHz Res B.W. (set span at 1 or .2 MHz/Div)
f) Optional 10 KHz Res B.W. (set span at .2 MHz/Div)
Extends lower frequency range to approximately 200 KHz.

Note: A Narrow Band Cavity Oscillator is swept for .2MHz/Div span so that signals can be observed with low oscillator noise contribution.
SENSITIVITY
-95 dBm
AMPLITUDE ACCURACY
+2 dB typical
FREQUENCY DISPLAY
4 digit LCD Frequency Readout
DIMENSIONS
11 1/2" W X 5 1/2" H X 13 1/2" D
WEIGHT
18 lbs. / 8.18 Kg
POWER REQUIREMENTS
External 115 VAC 60 Hz / 12 VDC
Internal 12V Gel Cell Battery
220/240 Volt models available

NSA-1000A Network And Spectrum Analyzer



SOURCE PEAKING Synchronizes the swept receiver to the source in the network analyzer mode.

SWEEP RATE controls the speed of the sweep across the CRT.

AUDIO activates audio demod board and sets audio level.

CENTER FREQUENCY is a 4 digit LCD display that allows you to accurately read center frequency of the NSA-1000A display in tenths of a MHz.

TUNING adjusts the center frequency of the analyzer so that signals of interest appear on the center of the display and their frequency is read out on the LCD.

SPAN controls the width of the spectrum being displayed.

Attractively styled package and ergonometrically engineered front panel for an instrument that is a pleasure to own and use.

FINE TUNE allows fine changes in center frequency. Greater adjustment range on left knob settings, finer adjustment on right knob settings.

Large bright screen for outdoor and indoor use. Scale calibrated in 10 dB steps for accurate repeatable measurements. 60 dB dynamic range.

VAR SPAN reduces the width of the spectrum being displayed for closer signal examination and enhanced amplitude accuracy.

INTENSITY controls the brightness of the display.

ZERO SPAN instantly places analyzer in zero span mode and activates audio demodulator for convenient monitoring.

POWER switch has 2 positions, ON and OFF. An amber LED is illuminated when POWER is ON.

INPUT REFERENCE LEVEL adjusts input attenuator and IF gain so that top graticule corresponds to indicated signal level. Calibrations in dBm are provided.

RF INPUT - PORT 2 - accepts signals to be observed from less than 2 MHz to greater than 1000 MHz.

HORIZ is used to position the display on the screen laterally.

VERT is used to position the display on the screen.

FREQ CAL adjusts frequency displayed on LCD.

EXT AUDIO drives low impedance earphones or speaker. Internal speaker provided with optional demod.

RF OUTPUT - PORT 1 1-1000MHz source for synchronized receiver.

OUTPUT ATT 30 dB step attenuator for RF OUTPUT.

RF OUTPUT activates and deactivates output at source - PORT 1.

Enhance your capabilities with the powerful performance of this revolutionary instrument.

The NSA-1000A is a powerful and versatile Integrated Network And Spectrum Analyzer. It can be used as a stand alone 1-1000 MHz spectrum analyzer with an internal FM demodulator or used as a network analyzer by activating its built in tracking generator.

Description

The NSA-1000A's front panel is functionally separated into 3 areas; the display, an RF source and a swept receiver (spectrum analyzer). The frequencies of the RF source and of the swept receiver track and the response of an RF network inserted between the RF source and receiver is displayed on a CRT. Step attenuators in the source and receiver facilitate measurement of lossy networks (i.e. filters, attenuators) and networks with gain (i.e. amplifiers).

Network Analyzer

The NSA-1000A used as a network analyzer allows the operator to make swept measurements of filters, duplexers and amplifiers from 1 to 1000 MHz with a dynamic range of > 90 dB. Stimulus-response measurements of other RF networks can be made. The NSA-1000A's flexibility is increased by a built in attenuation/reference level system. The lightweight NSA-1000A is the ideal instrument for testing of RF communication systems, classroom instruction, cable TV maintenance and production use.

Spectrum Analyzer

The NSA-1000A also functions as a versatile, and cost effective stand alone spectrum analyzer with a frequency range of 1 to 1000 MHz and a sensitivity of -95 dBm. The NSA-1000A is ideal for receiver and transmitter alignment and troubleshooting, LAN analysis, cable head end level balancing, satellite receiver alignment and signal demodulation (with optional demodulator). Other applications include classroom instruction, production testing, cable TV maintenance, amateur radio, and surveillance and countermeasures. Options include FM demodulator, AM detector, DC power inserter and LPA-1000 Log Periodic Antenna.

Return Loss Bridge Accessory

The NSA-1000A can make reflected measurements when used in conjunction with the RLB-1000, Return Loss Bridge. The RLB-1000 has a frequency coverage of 5-1000MHz and is useful in measuring VSWR - the return loss of antennas, filters or amplifiers.

NETWORK ANALYZER

SOURCE - PORT 1

FREQUENCY COVERAGE
1 MHz to 1000 MHz in one sweep.
OUTPUT ATTENUATION LEVELS
0, -10, -20, -30 dBm
OUTPUT CONNECTOR
Type BNC - F,SMA and N adapters available
AMPLITUDE ACCURACY
+ 2 dB typical
FLATNESS
< 4 dB P-P
IMPEDANCE
50 Ω

RECEIVER - PORT 2

FREQUENCY RANGE
1 MHz to 1000 MHz in one sweep.
MAXIMUM INPUT LEVEL
+15 dBm
RESOLUTION BANDWIDTH
150 KHz Fixed
INPUT REFERENCE LEVELS
+20, 0, -20, -40 dBm
INPUT CONNECTOR
Type BNC - F,SMA and N adapters available
IMPEDANCE
50Ω, 75Ω adapters available
CROSSTALK
< 92 dB over 90% of the bandwidth - typical

SPECTRUM ANALYZER - PORT 2

FREQUENCY COVERAGE
1 MHz to 1000 MHz in one sweep.
SENSITIVITY
-95 dBm typical
AMPLITUDE ACCURACY
+ 2 dB typical
RESOLUTION BANDWIDTH
150 KHz Fixed
REFERENCE LEVELS
+20, 0, -20, -40 dBm
INPUT CONNECTOR
Type BNC - F,SMA and N adapters available
OPTIONS
FM Demodulator
AM Audio Detector
ACCESSORIES
DCP-20 DC Power Inserter
LPA-1000 Log Periodic Antenna

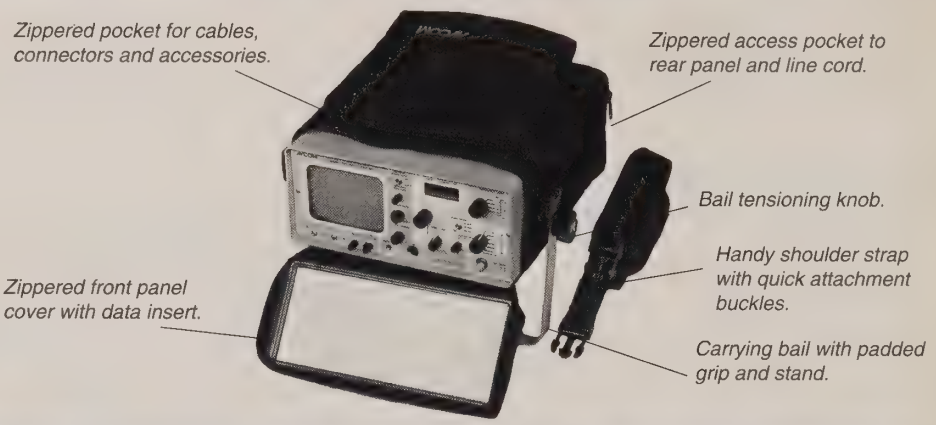
PHYSICAL CHARACTERISTICS

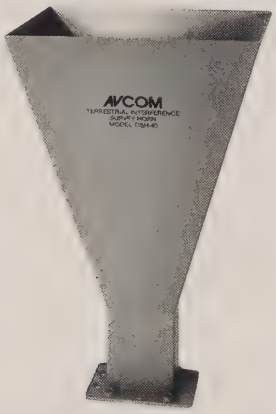
FREQUENCY DISPLAY
4 digit LCD Frequency Readout
100 KHz resolution
CRT DISPLAY
10 horizontal graticule Divisions (frequency) x 7 vertical graticule Divisions (amplitude). Each vertical Division equals 10 dB.
DIMENSIONS
11.5"W x 5.5"H x 15.5"D (290 x 125 x 385 mm)
WEIGHT
18 Lbs / 8.18 Kg
POWER REQUIREMENTS
External 115 VAC / 60 Hz
220/240 VAC / 50 Hz models available

PSA and PTR Accessories

AVSAC

The AVCOM AVSAC Spectrum Analyzer and Portable Test Receiver Carrying Case is an attractive and practical accessory for your AVCOM PSA or PTR. The AVSAC is made of durable black Cordura Nylon with a protective foam backing. The full length zipper opening on the front of the case allows you easy access to all of the necessary PSA or PTR operating controls. There is a large zippered pouch pocket on the top of the case for storage of accessories, cables, connectors, etc.... Strong poly-pro webbing reinforces the case and provides a secure mounting for the sturdy and adjustable/detachable shoulder strap with comfortable shoulder pad.

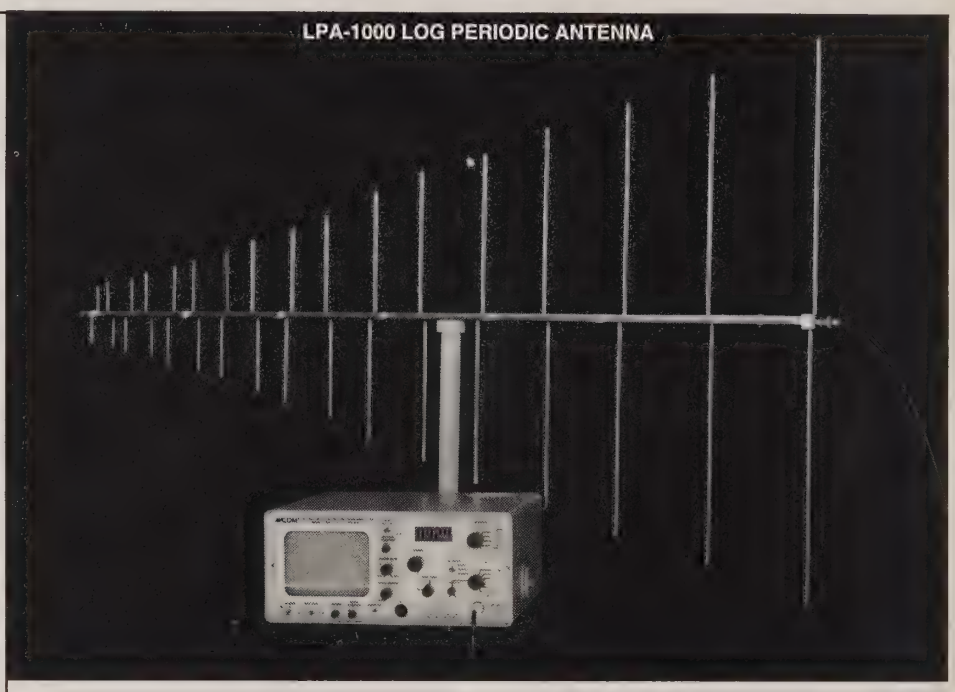




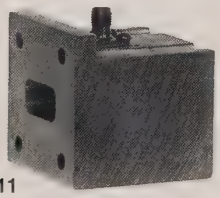
TISH-40 TERRESTRIAL INTERFERENCE SURVEY HORN

The TISH-40 Terrestrial Interference Survey Horn is used in conjunction with the PSA-35A and any LNA for site surveys. The TISH-40 features 18 dB gain in the 3.7 to 4.2 GHz range of frequencies. It is highly directional with high gain and rugged construction. The TISH-40 will allow the utility of the versatile PSA-35A Spectrum Analyzer. 1/4-20 stainless nuts pressed into the flange make LNA assembly and disassembly quick and easy.

Length 13.25" (33.65 cm)
Height 8.00" (20.32 cm)
Width 6.00" (15.25 cm)
Gain 18 dB



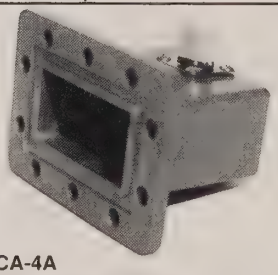
A high performance precision-machined log periodic antenna is available for the PSA-65A, as well as for use with other equipment. The LPA-1000 covers a frequency range from 140 MHz through 1000 MHz. The LPA-1000 is only 49 in. (125cm) in length and weighs 4 lbs.(1.8kg). A BNC connector is standard.



WCA-11 WAVEGUIDE TO COAX ADAPTER

The AVCOM WCA-11 Waveguide to Coax Adapter transforms signals in waveguide transmission line to coaxial line and vice versa. The adapter functions for signals in the 11.25-12.75 GHz range in either direction, waveguide to coax or coax to waveguide.

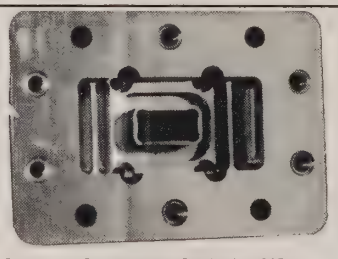
The WCA-11 is a one piece aluminum casting and comes with all necessary hardware for attachment to an LNB.



WCA-4A WAVEGUIDE TO COAX ADAPTER

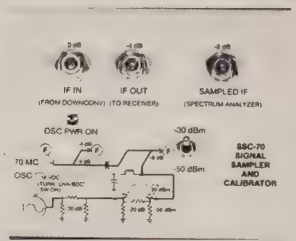
The AVCOM WCA-4A Waveguide to Coax Adapter transforms signals in waveguide transmission line to coaxial line and vice versa. The adapter functions for signals in the 3.7 to 4.2 GHz range in either direction, waveguide to coax or coax to waveguide.

The WCA-4A is a one piece aluminum casting and comes with all necessary hardware for attachment to an LNA, feed horn, or other accessories. It also has a tapped 1/4-20 bracket which enables mounting on most tripods.



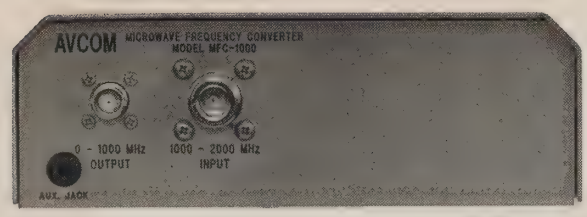
CKA-12 C BAND TO Ku BAND MICROWAVE FLANGE ADAPTER

The CKA-12 Microwave Flange Adapter for C to Ku band waveguide allows the use of larger C band waveguide components such as feed horns, transitions, etc.... with Ku band LNB's and LNC's. A unique feature of the CKA-12 is the combination of tapped and clearance holes which greatly simplify attachment of the CKA-12 to 12 GHz LNC's, feed horns or accessories, a 1/4-20 tapped hole is provided so the assembly can be mounted on a standard tripod.

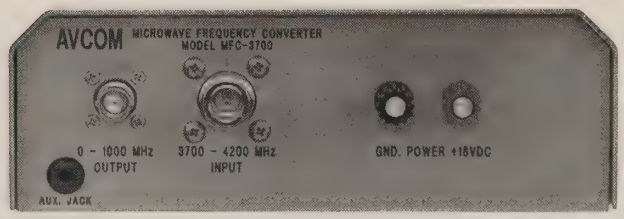


SSC-70 SIGNAL SAMPLER AND CALIBRATOR

The SSC-70 Signal Sampler and Calibrator is a valuable PSA-35A accessory for observing 70 and 135 MHz IF signals between a downconverter and receiver. A built in 70 MHz source allows verification setting of the PSA-35A frequency and amplitude. The SSC-70 will enable you to precisely align Terrestrial Interference Filters in the IF feedline of a TVRO system. The SSC-70 measures IF signals at the TVRO receiver during installation for precise documentation of system performance.



MFC-1000
1-2 GHz Frequency Extender

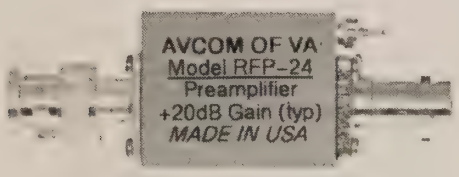


MFC-3700
3.7-4.2 GHz Frequency Extender with DC Insertion Posts

FREQUENCY EXTENDERS

AVCOM Frequency Extenders allow AVCOM PSAs as well as other manufacturers spectrum analyzers, to have greater versatility by increasing the frequency coverage. Standard Frequency Extenders include 1-2 GHz, 2-3 GHz, 1.7-2.7 GHz, 950-1450 MHz and 3.7-4.2 GHz. Other frequency bands may be customer specified. Frequency Extenders are microwave frequency converters (MFC) that consist of a mixer and oscillator tuned to downconvert the incoming signals so that the output falls between 0 and 1000 MHz.

The Frequency Extenders may be specified to be powered coaxially by the spectrum analyzer or by an external power supply. DC insertion posts may be added to provide a point for DC insertion to power LNAs, LNBs or Line Amplifiers. The PSA-65A recognizes which Frequency Extender is being used and displays the proper frequency on the center frequency display. The Frequency Extenders are packaged in a chassis that measures 6.5"W x 2.25"H x 7.25"D and two Extenders may be made in one chassis if specified when ordered.



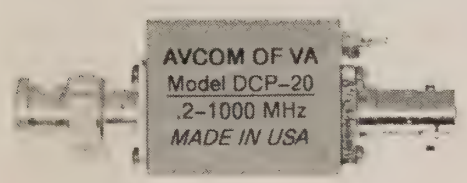
AVCOM RFP-24 RF PREAMPLIFIER

AVCOM makes a high performance RF preamplifier, the RFP-24, to enhance performance of the LPA-1000 Log Periodic Antenna, and for other applications where low noise signal amplification is required. The RFP-24 dramatically improves the sensitivity of any spectrum analyzer or frequency extender to frequencies in excess of 2 GHz. Used with AVCOM's PSA-65A Portable Spectrum Analyzer, signals weaker than one microvolt can be detected.

Technical specifications for Model RFP-24 include 22 dB gain through 2 GHz, noise figure of 2.2 dB at 1.2 GHz and 50 ohms input and output impedance. Power may be supplied by the PSA-65A front panel AUX jack or any source of 12 VDC.

A lower cost RF preamplifier, the RFP-25, is available with a slightly higher noise figure of 5.5 dB for applications that do not require the state of the art performance of the RFP-24.

The preamplifiers are packaged in a machined aluminum block with dimensions of 1.25" x 1.00" x .75". Customer may specify input and output connectors to be SMA, BNC, N or F of any gender.



AVCOM DCP-20 DC POWER INSERTER

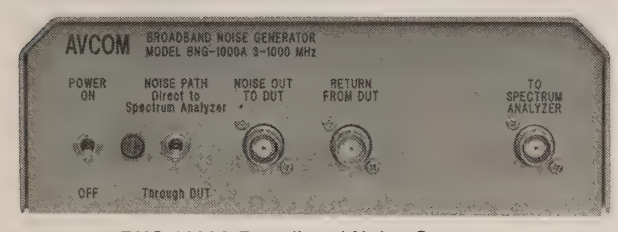
AVCOM introduces an addition to their line of DC power inserters, the model DCP-20. The versatile DCP-20 can be used as a DC block or as a means of inserting power into a coaxial transmission line.

One important application is to remotely power AVCOM's RFP series of RF preamplifiers through the feedline so the preamplifiers may be located at the antenna to eliminate coax losses.

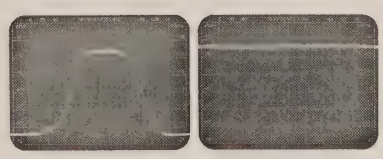
Users of expensive test equipment, such as signal generators and spectrum analyzers, can prevent costly attenuator and mixer burnout (from misconnected power supply leads, shorted DC blocking capacitors or carelessness) by use of the DCP-20 on RF ports.

Insertion loss of the DCP-20 is less than .3 dB through 2 GHz with an impedance of 50 ohms. Other impedances may be specified by the customer. The DCP-20 may be ordered with any mix or gender of SMA, BNC, N and F type connectors.

The DCP-20 is packaged in a machined aluminum block with dimensions of 1.25" x 1.00" x .75".



BNG-1000A Broadband Noise Generator



Left photo depicts a 70 MHz BP filter displayed on an AVCOM PSA-65A Portable Spectrum Analyzer with the BNG-1000A NOISE PATH in the Through DUT position. The right photo is the same set up with the BNG-1000A Direct To Spectrum Analyzer for quick insertion loss measurement.

The BNG-1000A Broadband Noise Generator adds to the capability of spectrum analyzers such as AVCOM's PSA-65A by allowing them to perform frequency response measurements similar to the use of a tracking generator. The BNG-1000A noise source is useful for sweeping coaxial cables, tuning filters and characterizing amplifiers. Integral RF switching allows the noise reference level to be displayed on the spectrum analyzer, and by a front panel switch, the device under test (DUT) is placed into the network and its response immediately observed. Insertion loss can be measured with the flip of a switch.

SPECIFICATIONS

Frequency Range
3-1000 MHz
Output Level
Using AVCOM's PSA-65A Portable Spectrum Analyzer -30 dBm with span set 100 MHz/Div and 3 MHz Res. B.W.
Flatness
± 3 dB typical
Power Requirements
+12 to +24 VDC @ 200mA
115 VAC to +12 VDC adapter provided
Powered by the AUX jack on the PSA-65A
Powered by the LNA/BDC power switch on the PSA-35A and PSA-37D (optional)
Dimensions
6.5"W x 2.25"H x 7.25"D
16.5cmW x 5.7cmH x 18.4cmD
Weight
2lbs./.9kg

NEW!!! LPF-1200 LOW PASS FILTER

AVCOM's LPF-1200 is a Low Pass Filter with a frequency coverage of 0-1200 MHz and minimum insertion loss. It can be used with signal generators, spectrum analyzers and frequency extenders to enhance their performance.

AVSTAND

The AVSTAND is a strong, stable and attractive equipment stand which gives the operator of a NSA, PSA, PTR, MSG, computer monitor, oscilloscope or other test gear more bench top area. The AVSTAND elevates the test equipment 8.25" creating a spacious test area with the results comfortably displayed at eye level.

QRM-35

AVCOM's Quick Release Rackmount Kit (QRM-35) allows the PSA-65A, PSA-37D, PSA-35A, MSG-1000B and PTR-25A to be installed in a standard 19" equipment rack. The front plate has 4 spring loaded thumbscrews for easy removal so that the PSA or PTR can be also used in the field and returned to the rack.

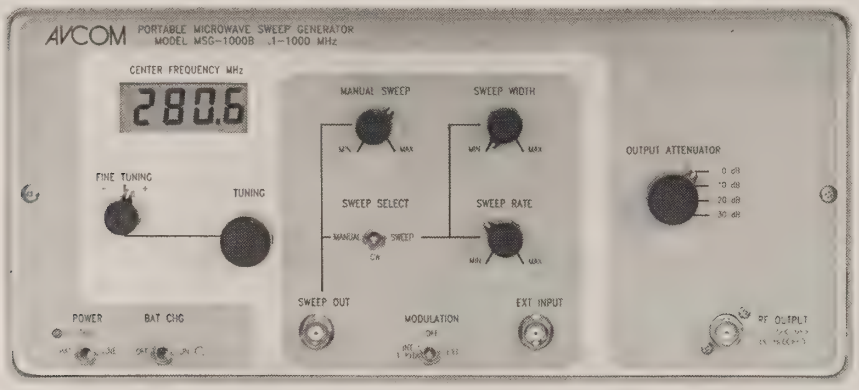
OVERLAYS

The AVCOM Overlays are handy die cut plastic sheets designed to fit over the CRT display of the PSA-35A, PSA-37D or PSA-65A Spectrum Analyzers. These can be used to document installations for future reference by tracing the display onto the overlay.

Microwave Sweep & Tracking Generators

AVCOM SWEEP/SIGNAL GENERATORS

AVCOM's Sweep Generators provide an economical means of producing accurate signals over a wide range of frequencies. Units are available for various bandwidths between 0 and 4000 MHz and for 3.7-4.2 GHz. Frequency is read on a built-in, crystal referenced, frequency counter LCD or LED display. The Sweep Generators can be used as marker generators for AVCOM's Portable Spectrum Analyzers (PSA-35A, PSA-37D, and PSA-65A) to accurately measure the frequency of displayed signals. Manual and automatic sweep capabilities are standard over the entire frequency band with sweep widths of the full bandwidth or less at the center frequency (within the range of the unit). The Sweep Generators are attractively packaged in an epoxy finished aluminum case and are extremely portable. They can be operated from 115 VAC (220 or 240 VAC available) or from their own internal rechargeable gel-cel batteries.



MSG-1000B Microwave Sweep Generator

AVCOM MSG-1000B MICROWAVE SWEEP GENERATOR 100 KHz to 1000 MHz

AVCOM's MSG-1000B Microwave Sweep Generator provides an economical means of producing accurate signals from 100 KHz to 1000 MHz. The MSG-1000B can be used as a marker generator for AVCOM's Portable Spectrum Analyzers (Models PSA-35A, PSA-37D, and PSA-65A) to accurately measure the frequency of displayed signals. Other applications include being a source to measure filter responses and amplifier gain in various types of communication equipment (i.e. satellite receivers, two-way radios, cellular systems...).

The MSG-1000B has an optional 30dB step attenuator (in 10dB steps) to accurately regulate the RF signal output. Frequency is read on a built-in, crystal referenced, frequency counter LCD display. Manual and automatic sweep capabilities are standard over the entire frequency band with sweep widths of the full bandwidth or less at the center frequency (within the range of the unit).

Physically the MSG-1000B is attractively packaged in an epoxy finished aluminum case and is extremely portable. It can be operated from 115 VAC (220 or 240 VAC available) or from its own internal rechargeable gel-cel batteries.

FREQUENCY RANGE
100 KHz to 1000 MHz (Standard)
1500 MHz to 2500 MHz (optional)
1700 MHz to 2700 MHz (optional)
FREQUENCY ACCURACY
+ 200 KHz
LCD DISPLAY ACCURACY
4 digit, + 100 KHz
OUTPUT LEVEL
-10 dBm
ATTENUATION LEVELS (optional)
0, -10, -20, -30 dB
AMPLITUDE ACCURACY
+ 2 dB
LEVEL FLATNESS (100 KHz - 1000 MHz)
< 4 dB P-P
RF OUTPUT CONNECTOR
Type BNC - F, N, and SMA adapters available
IMPEDANCE
50 Ω
REVERSE POWER PROTECTION
RF - +15 dBm
DC - +50 VDC
INTERNAL FM MODULATION
Deviation - 150 KHz
FM rate - 1 KHz
EXTERNAL MODULATION
RF maximum input - 0 dBm
DC protection - +50 VDC
Deviation Approx. - 1 KHz/mV
EXTERNAL MOD. INPUT CONNECTOR
Type BNC - F, N, and SMA adapters available
SWEEP WIDTH
Variable 100 KHz - 1000 MHz
Automatic and Manual modes
SWEEP RATE
Variable .5 - 30 Hz (approx.)
SWEEP OUT
4-8 Volt P-P linear ramp
OPERATING TEMPERATURE
0 to 55 degrees Centigrade
POWER REQUIREMENTS
115 VAC (220/240 VAC models available)
External 12 - 18 VDC
Internal Rechargeable Batteries
WEIGHT
14 lbs
DIMENSIONS
11.5"W x 5.5"H x 13.5"D
RACK MOUNT (optional)
The MSG-1000B is rack mountable with the use of AVCOM's QRM-35 quick release rack mount kit.

AVCOM MSG-5
MICROWAVE SWEEP GENERATOR 3.7 TO 4.2 GHz

AVCOM's MSG-5 Microwave Sweep Generator provides the capability of generating very accurate signals in the 3.7-4.2 GHz satellite communications band. A sweep capability is standard over the entire 3.7-4.2 GHz band to bandwidths less than one MHz at any center frequency between 3.7 and 4.2 GHz. Frequency can be read on an LED display with + 1 MHz accuracy. A built-in modulation generator can verify TVRO system performance. An external video modulation input is included. The MSG-5 features line or battery operation, portability, and rugged construction.

AVCOM MSG-1750A
MICROWAVE SWEEP GENERATOR 950 TO 1750 MHz

The MSG-1750A digital frequency readout is accurate to + 1 MHz. The MSG-1750A has been developed for international use with the wider block frequency band from 950 to 1750 MHz. Operation from 115 VAC is standard, 220/240 VAC is available. The MSG-1750A can be used as a marker generator for AVCOM's Portable Spectrum Analyzers (PSA-35A, PSA-37D and PSA-65A) to accurately specify TI filters or to establish performance criteria for satellite communications contracts.



AVCOM MTG-3600 TRACKING GENERATOR

The AVCOM MTG-3600 turns your HP 8566 spectrum analyzer into a powerful network analyzer with scalar frequency response function allowing you to align filters and amplifiers in seconds.

AVCOM Tracking Generators can be ordered with output frequency offset (by the amount of the device under test IF frequency for example), to meet specific application requirements.

AVCOM's Model MTG-3600 Tracking Generator outputs a -5dBm (typical) tracked RF signal from less than 100 KHz to over 1.0 GHz. Flatness + 1.5 dB typical. IF feed thru below -65 dBm typical. L.O. is a phase locked cavity oscillator referenced to an oven stabilized crystal oscillator.

OTHER TRACKING GENERATOR / ANALYZER COMBINATIONS AVAILABLE. CALL US WITH YOUR REQUIREMENTS.

MTG-3600 SPECIFICATIONS

Tracked Signal Response	100 Hz - 1.0 MHz +0.1 dB 1.0 MHz - 1.0 GHz +1.5dB
Tracked Signal Accuracy	<300 Hz; tracking adjustment provided on front panel
Output Level	-5 dBm +1dBm
Output Impedance	50 ohm (approximate - mixer impedance varies so an attenuator of 6 dB should be used).
L.O. Source	Cavity oscillator phase locked to an oven stabilized crystal reference.
IF Feed Thru	Less than -65 dBm (3621.4 MHz)
Reference Stability	.005 %
Dimensions:	4"H x 8.5" W x 12" D
Rackmount	3.5"H x 19"W x 14"D
Power	115V, 60Hz, 20 Watts
Options	220/240 VAC 19" Rack mount chassis

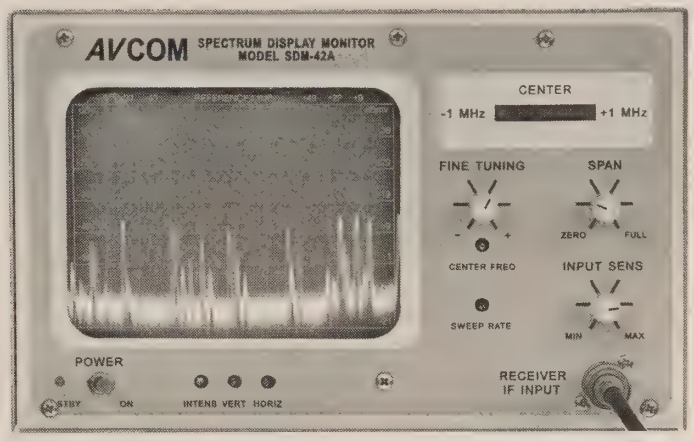
SDM-42A Spectrum Display Monitor

AVCOM's new SDM-42A Spectrum Display Monitor is designed for use as a panoramic signal display for VHF scanners and communication receivers such as the ICOM R-7000. The SDM-42A displays all signals present in the receiver's IF on a 5" CRT so that the operator can monitor signal activity. The operator can then quickly tune to signals as they appear on the spectrum display. This greatly facilitates locating and tuning of intermittent signals as well as surveilling a particular frequency band. The SDM-42A Spectrum Display Monitor (with a scanner) can be used with AVCOM's PSA-65A Portable Spectrum Analyzer to create a powerful broad and narrow band spectrum monitoring system.

The SDM-42A spectrum display can be used for other applications such as monitoring satellite receiver IF's and demodulating single channel per carrier satellite signals (with optional demodulator circuitry). It can also be used as a general purpose spectrum analyzer covering specific frequency ranges.

SPECIFICATIONS

IF INPUT
Customer specified. Standard frequencies include 10.7, 21.4, 45 and 70 MHz
RESOLUTION BANDWIDTH
10 KHz Standard
DYNAMIC RANGE
65 dB
FREQUENCY DISPERSION (SPAN)
Variable from + 5 MHz of center frequency to zero span
AMPLITUDE SENSITIVITY
10 dB/Div
POWER REQUIREMENTS
110 VAC/60 Hz (other voltages available upon request)
DIMENSIONS
8.25" x 5.00" x 11.00"
209mm x 127mm x 279mm
WEIGHT
8.25 lbs (3.75 Kg)

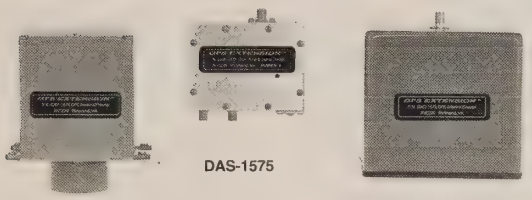


SDM-42A Spectrum Display Monitor

GPS Extension™

GPS Antenna Extender

Test and train on GPS systems comfortably and quickly - INDOORS!!!



GAP-1575 DAS-1575 GAC-1575

GAE-1575

Operate your GPS receiver in the vehicle indoors with AVCOM's new GPS Antenna Extender, Model GAE-1575. Save time and money with this innovative device. Eliminates the need to move GPS systems outdoors for preliminary testing and /or training. You'll appreciate it in hot or cold weather.

The ***GPS Extension***™ consists of the GAP-1575 GPS Antenna and Preamplifier, the DAS-1575 Distribution Amplifier and Signal Divider, and the GAC-1575 GPS Antenna Coupler. The GAP-1575 is an antenna and low noise amplifier assembly mounted outdoors in a clear area where it receives and passes GPS signals to the DAS-1575 via inexpensive coax. The DAS-1575 mounts inside where it powers the GAP-1575, amplifies and distributes GPS signals to the Antenna Coupler. The GAC-1575 Coupler is placed over the GPS vehicular antenna and the GPS system will indicate the position of the GAP-1575 Antenna allowing **INDOOR** maintenance and/or training.

INMARSAT COMPONENTS
Feed, BP Filter, LNA and Downconverter

CIRCULAR FEED ASSEMBLY

Constructed of aluminum and acrylic.
7 hole flange so that feed can be mounted on either 3 or 4 post.

RF Output Connector	Type N Female
Frequency	1530-2252.2 MHz

LNA LOW NOISE AMPLIFIER

Gain	35 dB
Noise Figure	1 dB
Bandwidth	200 MHz
Frequency	Customer specified between 1530-2252.2MHz
Power	+ 12 to 16 VDC Coaxially powered
Connectors	SMA Female

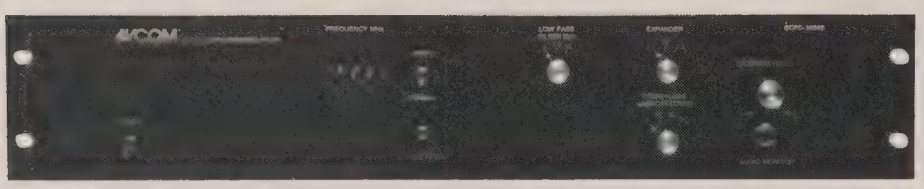
BANDPASS FILTER

Frequency	Customer specified between 1530-2252.2MHz
Filter Bandwidth	18.5 MHz typically
Connectors	SMA Female

DOWNCONVERTER

Input Frequency	Customer specified between 1530-2252.2 MHz
Output Frequency	Customer specified. Standard frequencies include 137.5, 70, 21.4 and 10.7 MHz
Stability	Customer Specified. Phased locked or free running
Gain	30 dB
Power	+ 15 to 18 VDC, Coaxially powered

Single Channel Per Carrier Equipment



AVCOM SCPC-3000E AGILE SINGLE CHANNEL PER CARRIER DEMODULATOR

AVCOM introduces a fully agile Single Channel Per Carrier Demodulator, the SCPC-3000E, for versatile and economical reception of SCPC signals.

The SCPC-3000E Demodulator features a high performance synthesized 50-90 MHz tuning module for maximum system versatility. Frequencies are tunable in 800 steps of 50 KHz each. Standard expansions are 3:1 and 2:1, other expander formats are available. De-emphasis is switchable between 0, 25, 50, and 75 microseconds. Selectable low-pass 15, 7.5, and 5 KHz audio filters are standard. The SCPC-3000E is rack-mountable and available for immediate delivery. AVCOM can customize the SCPC-3000E Agile SCPC Demodulator to suit specific receiver needs, contact AVCOM with your requirements.

FEATURES

*Fully Agile High-Performance Receiver
*Adaptable to Variety of De-emphasis Requirements
*Selectable Expansion
*Selectable Audio Filters
*Excellent Signal-to-Noise and Carrier-to-Noise Performance
*On-Board Driver Stage for Low-Impedance Headphones
*Standard Rack Mount Cabinet

SPECIFICATIONS

Tuning Range	Fully Transponder, 40 MHz
Frequency Stability	.005% Crystal, Synthesized
Input Frequency	50 - 90 MHz
Input Impedance	50 - 75 Ω
De-emphasis	0, 25, 50, 75, Microseconds
Expander	3:1 and 2:1 standard, dual expanders optional, other expander formats available.
Audio Filter	Switchable Low-Pass 5,7.5,15KHz
Minimum Input Level	-50dBm
AFC Tracking	±50 KHz
Narrow Predetection Bandwidth	60 KHz High Q Toroidal Filter (other bandwidths optional)
Wide Predetection	150 KHz Ceramic Filter Band width (other bandwidths opt.)
Adjacent Channel Rejection	-65 db ±300 KHz From Desired Channel Frequency
Narrow IF Center Freq.	4.5 MHz
Wide IF Center Freq.	10.7 MHz
Demodulator Type	Quadrature Detector
Threshold	7.5 dB Carrier-to-Noise
Total Harmonic Distortion	0.9%
Conversion Format	Triple Conversion Superhetrodyne
Flatness	±1 dB/40 MHz
IF Output Frequency	70 MHz ±18 MHz
IF Output Impedance	50 - 75 Ω
Channel Selection	800 (50 KHz) Steps, Synthesized
Audio Output	600 Ω Balanced (Transformer Isolated)
Image Rejection	50 dB Typical
Power Requirements	115 V, 60 Hz, 50Watts
International Option	200/240V, 50-60 Hz
Dimensions	Standard 19" Rack Mount, 3 1/2" Rack Height, 14" Deep



AVCOM SCPC-500-70 SINGLE CHANNEL PER CARRIER DOWNCONVERTER

AVCOM's Single Channel Per Carrier Downconverter, Model SCPC-500-70, has been developed for the reception of FM SCPC signals from satellites operating in the 3.7 - 4.2 GHz band. The SCPC-500-70 downconverter is compatible with many industry standard receivers (demodulators).

At the heart of AVCOM's SCPC-500-70 is a sophisticated phase locked microwave oscillator and multiplier system that enables the SCPC-500-70 to exhibit exceptional stability. No other equipment at a comparable price can offer the performance of the SCPC-500-70 downconverter. The SCPC-500-70 is designed for mounting in a standard 19 inch equipment rack or cabinet. The unit requires a panel space of 3 1/2 inches.

FEATURES

*Extremely Stable Downconverter
*Standard 19" Rack Mount
*Compatible with most industry standard receivers (demodulators).

SPECIFICATIONS

Tuning Range	Full Transponder
Internal Downconverter	High stability, very low phase noise, phase locked cavity oscillator, oven stabilized crystal reference.
Frequency Stability	0.005% Standard Oven Oscillator
Input Frequency	3.7 to 4.2 GHz
Input Impedance	50 - 75 Ω
Output Impedance	75 Ω Terminates Unused Outputs
Min. Input Level	-50 dBm
IF Center Frequency	70 MHz
Flatness	±5 dB / 500 MHz
IF Output Frequency	50 - 90 MHz
Channel Selection	External Receiver (SS-1000 or SCPC-3000E), other manufacturer's demodulators
Image Rejection	40 dB Typical
Power Requirements	115VAC, 60 Hz, 50 Watts
International Option	220/240 VAC, 50 Hz - 60 Hz
Dimensions	3 1/2" H x 19" W x 14" D

AVCOM SS-1000 SINGLE CHANNEL PER CARRIER DEMODULATOR

AVCOM's Single Channel Per Carrier Demodulator, Model SS-1000, has been developed for the demodulation of FM SCPC signals from the 70 MHz IF output of a downconverter. The SS-1000 is a complete demodulator that can tune up to 4 specific crystal controlled audio or data channels from a given transponder and adapt to a variety of de-emphasis requirements. The SS-1000 is available in either wide band or narrow band models. Multiple SS-1000's may be used for simultaneous reception of additional channels.

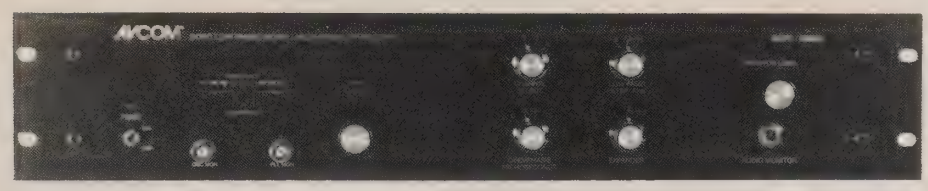
Included in the SS-1000 is AVCOM's audio expander module. This module is a cost effective means of obtaining 1 - to -2 or 1 - to -3 expansion with a choice of 0, 25, 50, or 75 microsecond de-emphasis.

Other features include low pass 15, 7.5, or 5 KHz audio filters and an on-board driver stage for low impedance earphones. The SS-1000 is designed for mounting in a standard 19 inch equipment rack or cabinet.

SPECIFICATIONS

Tuning Range	Full Transponder
Input Frequency	50-90 MHz (extended frequency coverage available)
Input Impedance	50 - 75 Ω
Min. Input Level	-50 dBm
AFC Tracking	±50 KHz
Predetection Bandwidth	60 KHz High Q Toroidal Filter (Narrow Band)
Adjacent Channel Rejection	-55 dB ±300 KHz from desired channel frequency
Image Rejection (1st IF)	50 dB Typical
IF Center Frequency	4.5 MHz
Demodulator Type	Linear Quadrature Detector
Threshold	7.5 dB C/N
Total Harmonic Distortion	<0.9%
Conversion Format	Double (Triple with microwave selection)
Channel Selection	Crystal Controlled
Power Requirements	115 VAC, 60 Hz, 50 Watts
International Option	220/240 VAC, 50 Hz - 60 Hz
Mounting Size	Standard 19" Rack Mount 3 1/2" Rack Height, 14" Deep

Single Channel Per Carrier Equipment



AVCOM SCPC-2000E SINGLE CHANNEL PER CARRIER RECEIVER

AVCOM's Single Channel Per Carrier Receiver, Model SCPC-2000E, has been developed for the reception of FM SCPC signals from satellites operating in the 3.7 to 4.2 GHz band. The SCPC-2000E is a complete receiver that can tune up to 4 specific crystal controlled audio or data channels from a given transponder and adapt to a variety of de-emphasis requirements. The SCPC-2000E is available in either wide band or narrow band models. The SCPC-2000E may be used with the SS-1000 Slave for simultaneous reception of additional channels.

At the heart of AVCOM's SCPC-2000E is a sophisticated phase locked microwave oscillator and multiplier system that enables the SCPC-2000E to exhibit exceptional stability. You can obtain very high audio or data signal to noise ratios with the AVCOM SCPC-2000E. No other equipment at a comparable price can offer the performance of the SCPC-2000E receiver. A variety of expander modules are available in the SCPC-2000E making it compatible with most existing systems. The SCPC-2000E is designed for mounting in a standard 19 inch equipment rack or cabinet. The unit requires a panel space of 3 1/2 inches.

SPECIFICATIONS

DOWNCONVERTER

Internal Downconverter High stability, low phase noise, phase locked cavity oscillator, oven stabilized crystal reference.

IF PROCESSOR

Tuning Range	Full Transponder
Frequency Stability	0.005% Standard Oven Oscillator
Input Frequency	3.7 to 4.2 GHz
Input Impedance	50 - 75 Ω
Min. Input Level	-50 dBm
AFC Tracking	±50 KHz
Predetection Width	60 KHz High Q Toroidal Band Filter (other bandwidths optional)
Adjacent Channel Rejection	-65 dB ±300 KHz from desired channel frequency
IF Center Frequency	4.5 MHz
Demodulator Type	Quadrature Detector
Threshold	7.5 dB Carrier-to-Noise
Total Harmonic Distortion	<1.0%
Conversion Format	Triple Conversion Superhetrodyne
Flatness	±1 dB/40 MHz
IF Output Frequency	70 MHz ±18 MHz
IF Output Impedance	50 to 75 Ω
Channel Selection	Crystal Controlled
Audio Output	600 Ω Balanced (Transformer Isolated)
Image Rejection	50 dB Typical
Power Requirements	115 VAC, 60 Hz, 50 Watts
International Option	220/240 VAC, 50-60Hz
Mounting Size	Standard 19" Rack Mount 3 1/2" Rack Height, 14" Deep



SCPC-97 FULLY AGILE, SINGLE CHANNEL PER CARRIER, HIGH PERFORMANCE, INTERNATIONAL SATELLITE RECEIVER

The Model SCPC-97 Satellite Receiver is a high performance and fully agile satellite receiver system.

Using block downconversion techniques eliminates the need for bulky and expensive feedline, and since the microwave circuitry in the block downconverter can be shared by several receivers, additional cost savings can be effected.

The SCPC-97 is fully agile, allowing you to select the desired transponder, and then tune all signals between 50 and 90 MHz present on the selected transponder. A LCD readout displays the selected frequency in MHz. The IF bandwidth of the audio demodulator can be switched between "narrow" (normal position) and "wide" (used in many international transmissions). A full range of audio outputs are available to meet most requirements.

The SCPC-97 mounts in a standard 19 inch equipment rack and occupies 3 1/2 inches of vertical space.

The feedline connecting the SCPC-97 and the block downconverter can be RG-59 for cable lenghts up to 150 feet with up to a four way power split.

FEATURES

*Compatible with existing 950 to 1450 BDC Systems
*Both transponder and frequency agile.
*Switchable IF bandwidth for reception of both domestic and international broadcasts.
*LCD Frequency Readout

SPECIFICATIONS

RF INPUT

Input Level	-70 dBm to -25 dBm
Frequency	950 - 1450 MHz
Impedance	75 Ω
Power Gain	18 dB Typical
Noise Figure	-12 dB Typical
Image Rejection	35 dB Typical
Connector Type	Type F

IF

Manual Gain Control	24 dB Variation
Frequency	70 MHz
Bandwidth	40 MHz
Tracking Filter	40 MHz

AUDIO

The SCPC-97 incorporated a tunable audio demodulator.

Frequency Tuning	50-90 MHz Continuous Range (LCD Display)
Frequency Response	.30 Hz to 15 KHz ±1 dB
De-emphasis	75 Microsecond
Output Level	.7 Volt Peak to Peak
Harmonic Distortion	1.8%
Output High	600 Ω Balanced and Unbalanced
Output Low	8 Ω 1 Watt Max (front panel controlled)

PHYSICAL

Dimensions	3.5" H x 14" D x 19" W
Weight	12 lbs
Power Requirements	100 to 130 VAC, 60 Hz, 45 Watts
Operating Temperature	5 to 40 C



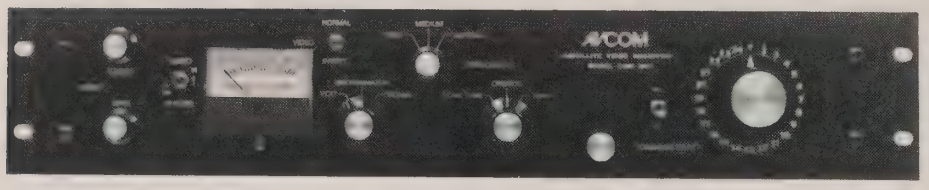
AVCOM's SCPC-500 SINGLE CHANNEL PER CARRIER IF PROCESSOR

AVCOM's Single Channel Per Carrier Intermediate Frequency Processor, Model SCPC-500, block converts all signals on transponders 1 through 24 to an intermediate frequency of 50 to 550 MHz. An extremely stable microwave oscillator with excellent phase noise characteristics allows unattended reception over long periods of time without significant drift. The low phase noise characteristic of the oscillator results in a high signal to noise ratio.

The SCPC-500 IF Processor is to be used with any commercially available receiver that can tune and demodulate any or all of the 50 to 550 MHz frequency range. FM tuners, wide coverage scanner, TV receivers, etc....can all be used to monitor the SCPC-500 IF output signals. It is possible to log SCPC traffic with the SCPC-500 and an inexpensive, wide coverage synthesized scanner. Due to the high stability of the phase locked oscillator, frequencies can be remonitored weeks later without resetting the synthesized scanner.

The low price of the SCPC-500 combined with its outstanding frequency stability make it the solution for anyone wanting reliable and affordable SCPC reception. (Use AVCOM's SCPC-2000E Receiver for domestic commercial SCPC reception).

Satellite Video Receivers



COM-96T Ku and C BAND COMPATIBLE SATELLITE RECEIVER

The AVCOM COM-96T is a professional receiver and is compatible with all Ku and C Band LNB's and BDC's that operate in the 950 to 1450 MHz range (950 to 1750 MHz range available upon request). The COM-96T provides complete 4 and 12 GHz performance in one system.

The COM-96T is a high performance, fully agile, dual conversion satellite receiving system for demanding commercial applications. Modular circuit packaging results in a compact and highly reliable Ku and C band receiver in a standard 19" rack mount configuration. Highly stable oscillators eliminate frequency drift and allow operation over wide temperature ranges. Tunable transponder settings allows the COM-96T to receive offset and half transponders. Special threshold extension circuitry offers superior video quality. The COM-96T may be ordered with optional threshold peaking and dual IF filters for receiving international type transmissions.

FEATURES

*Ku and C Band Compatible
*Commercial Quality
*Tunable Transponder Settings
*Optional PAL and SECAM Formats
*Double Conversion
*High Stability
*Tunable Audio with Wide and Narrow IF Filters
*Sensitive Signal Strength Meter

SPECIFICATIONS

RF INPUT

Input Level	-70 dBm to -25 dBm
Frequency	950 - 1450 MHz (950 -1750 MHz optional)
Impedance	75 Ω
Power Gain	18 dB typical
Noise Figure	-12 dB typical
Image Rejection	35 dB typical
Connector Type	Type F

IF

Manual Gain Control	24 dB variation
Frequency	70 MHz
Bandwidth	Switchable 18, 24, and 30 MHz
Dynamic Range of Threshold Extension	>20 dB

VIDEO

Impedance	75 Ω
Return loss	>25 dB
Polarity	Switch Selectable, Black to White, Normal or Inverted
Clamping	Fully active, 40 dB
Output Level	1 Volt P-P Adjustable
De-emphasis	Standard NTSC (PAL and SECAM available)

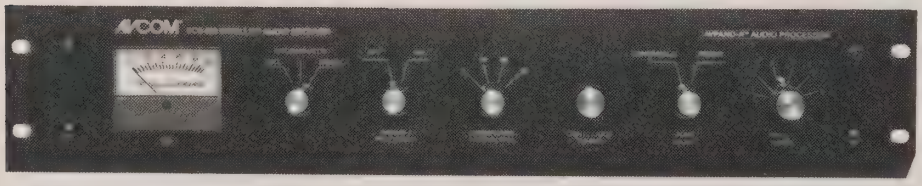
AUDIO

The COM-96T incorporates a tunable audio demodulator.

Frequency Response	30 Hz to 15 KHz ±1 dB
De-emphasis	75 microseconds
Output Level	.7 Volt peak to peak
Harmonic Distortion	< 1.8%

Physical

Dimensions	3.5"H x 14"D x 19"W
Power Requirements	100 to 130 VAC, 60 Hz, 45 Watts



AVCOM TUNABLE SCS-200 SATELLITE AUDIO RECEIVER

AVCOM manufactures tunable SCS Receivers for major religious, communications, and news networks. These receivers are designed to be compatible with United Video's satellite communications system (SCS). This system makes use of audio subcarriers on a video transponder for program distribution to radio broadcasters, supermarket networks, data services, etc...via satellite.

The AVCOM SCS-200 Satellite Audio Receiver (wideband) is a complete receiver and consists of a high stability microwave downconverter and a frequency agile SCS audio demodulator for use with LNB type systems, an optional downconverter is available for LNA type systems.The AVCOM SCS-200 has front panel controls for preset tuning of 4 different frequencies, full transponder continuous tuning, variable de-emphasis, and the AVCOM AVPAND-A Audio Processor.

Baseband output to drive competitive demodulators is standard. Narrow band versions are available. The AVCOM Tunable SCS-200 Receiver is compatible with major SCS audio system suppliers.

SPECIFICATIONS

RF Input Frequency	950-1450 MHz (other frequencies optional)
IF Frequency	70 MHz
IF Gain Control	24 dB Variation
IF Bandwidth	17.5 MHz (other bandwidths optional)
Threshold	7.5 dB/CN

BASEBAND COMPOSITE VIDEO

Level	1 Volt Peak to Peak
De-emphasis	Standard NTSC
Impedance	75 Ω
Return Loss	25 dB
Polarity	Switch Selectable, Black to White, Normal or Inverted

AUDIO DEMODULATOR

Tuning Range	.1 to 5.1 MHz
Bandwidth	120 KHz (other bandwidths opt.)
De-emphasis	0, 25, 50, or 75 Microseconds
Frequency Response	30 Hz to 15 KHz Typical
Demodulation Type	Quadrature Detector
AFC Tracking	±50 KHz
Adjacent Channel	-65 dB±300 KHz Rejection from desired channel
Audio Option	AVPAND-A Audio Processor
Total Harmonic Distortion	>0.9%
Output Impedance	600 Ω Balanced or Unbalanced
Output Level	0 dB Typical

INTERNATIONAL SATELLITE RECEIVERS

The COM-96T, COM-66T, COM-3 and COM-3R are available with international options that result in a receiver offering the ultimate in threshold performance and reliability for demanding and specialized International Satellite reception requirements. Special features include threshold peaking and electronically switched full and half transponder IF filters for reception of weak Intelsat type transmissions. The threshold peaking adjustments dramatically optimize the video quality for transmissions with low carrier to noise ratios.

BLOCK DOWNCONVERTERS AND MICROWAVE FREQUENCY CONVERTERS

AVCOM designs and produces block downconverters and microwave frequency converters for specific customer requirements as well as for use with AVCOM's receivers and spectrum analyzers. ***CALL AVCOM WHEN YOU ARE IN NEED OF A CUSTOMIZED FREQUENCY CONVERTER.***

Model	RF Input Frequency	Input Impedance	RF Output Frequency	Output Impedance	Comments
BDC-60	3.7 to 4.2 GHz	50 ohms	270 to 770 MHz	75 ohms	
RDC-11A	3.7 to 4.2 GHz	50 ohms	70 MHz	75 ohms	Receiver tunable
RDC-20	3.7 to 4.2 GHz	50 ohms	70 MHz	75 ohms	Fixed to a specific transponder
RDC-3	3.7 to 4.2 GHz	50 ohms	70 MHz	75 ohms	For use with COM-3/COM-3R
RBT-90	950 to 1450 MHz	75 ohms	70 MHz	75 ohms	Receiver tunable
MFC-2300	2.30 to 2.45 GHz	50 ohms	950 to 1450 MHz	75 ohms	

COM-3R



AVCOM VIDEO RECEIVERS WITH EXCELLENT THRESHOLD EXTENSION PROVIDE EXCELLENT RECEPTION WITH SMALL ANTENNAS/ WEAK SIGNALS

The AVCOM line of commercial receivers with high performance demodulators and superior threshold extension will enable you to achieve higher quality, better fidelity video with a given size dish. In applications where space or legal restrictions mandate the use of small marginal performance antennas, the installation of an AVCOM receiver will maximize system performance and quite often result in improved video reception.

COM-3R SATELLITE RECEIVER

The AVCOM COM-3R Satellite Receiver features 24 channel detent tuning and a complete array of comprehensive controls located conveniently on an armchair remote console. Standard features include APS-24 Automatic Polarity Switching, crystal controlled modulator, unclamped video output for decoders, tunable audio (4 to 8 MHz) with wide and narrow bandwidth, adjustable signal strength meter, excellent threshold sensitivity, scan tune, and internal D.C. power block. Numerous factory installed options and configurations make AVCOM's COM-3R the receiver of choice for the most demanding and unusual installations.

OPTIONS

* Interfaces for Prosat 230+, Tracker IV Plus, and Tracker IV Super Plus.
* Polarotor I and II Controls
* Electrically switched full and half transponder IF filters for reception of weak Intelsat type transponders as well as standard US and Canadian domestic satellite signals.
* Threshold peaking for optimum video quality with International Satellite transmissions, and low carrier to noise ratio transmissions.
* Custom rear panel connector configurations.
* Remote console can be ordered with scan tune and signal strength meter.

COM-3 SATELLITE RECEIVER

The AVCOM COM-3 circuitry is identical to the COM-3R, the difference being the location of all necessary controls on the unit's front panel for situations that do not require remote control.

SPECIFICATIONS

RF INPUT

Input Level	-55 to -25 dBm
Frequency	3.7 to 4.2 Ghz
Impedance	50 Ω
Return Loss	~15 dB
Noise Figure	~12 dB
Image Rejection	25 dB Nominal
Connector Type	Type N

IF

IF Frequency	70 MHz
IF Bandwidth	30 MHz Standard (other bandwidths available)
IF Input Level	-50 to -20 dBm
Threshold Level	Better than 8 dB C/N
Dynamic Range of Threshold Extension	>20 dB

VIDEO

Impedance	75 Ω
Return Loss	>25 dB
Polarity	Switch Selectable, Black to White, Normal or Inverted
Clamping	Fully Active, 40 dB
Output Level	1 Volt Peak to Peak, Adjustable
De-emphasis	Standard NTSC

AUDIO DEMODULATOR

Tuning Range	4.2 to 8.1 MHz
Bandwidth, Dual	280 KHz Wide, 120 KHz Narrow
De-emphasis	75 Microseconds
Frequency Response	30 Hz to 15 KHz
Output Impedance	600 Ω Balanced/Unbalanced
Output Level	1 Volt, Adjustable

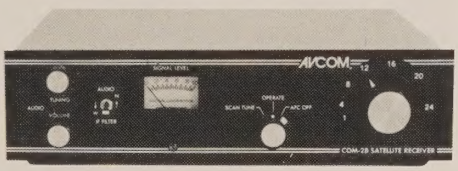
PHYSICAL

Dimensions	5" H x 17" W x 17" D
Weight	16.5 lbs



COM-2A

The COM-2A Satellite Receiver is ideally suited for economical installations where maximum reliability and high performance are important considerations. Excellent results over long cable runs make the COM-2A a good choice for installations requiring distant antenna placement. AVCOM's COM-2A has easy to use full function controls conveniently located on an attractive and convenient remote console. The large continuous tuning knob and carefully designed automatic frequency control make transponder selection easy and reliable. The absence of individually calibrated detents serves to eliminate seasonal service adjustments. The COM-2A has extended threshold performance, a sophisticated tunable audio system with wide and narrow IF filters (to allow reception of special audio subcarrier frequencies), video inversion switch, remote downconverter, adjustable sensitivity signal strength meter, scan tune (to help in antenna positioning), built in DC power block internal crystal controlled modulator, unclamped video jack for decoders, and numerous other features which make the AVCOM COM-2A one of the best values in economical high performance satellite receivers. AVCOM can custom tailor your COM-2A with Polarotor I and II controls.



COM-2B SATELLITE RECEIVER

The AVCOM COM-2B circuitry is identical to the COM-2A, the difference being that all necessary controls are conveniently located on the unit's front panel, for those occasions when remote control is not desired.

AVCOM can custom tailor your COM-2B with the following factory installed options: Polarotor I or II controls, interfaces for Prosat 230 +, Tracker IV Plus, and Tracker IV Super Plus for those who prefer "wireless" remote control.

COM-2A AND COM-2B SPECIFICATIONS

RDC-11 REMOTE DOWNCONVERTER

(Included with Receivers)

Input Frequency	3.7 to 4.2 GHz
Input Impedance	50Ω
Input Level	-55 to -25 dBm
Bandwidth	500 MHz
Flatness	±8 dB/100 MHz
IF Output Frequency	70 MHz
IF Output Impedance	75Ω
Image Rejection	23 dB Nominal
Supply Voltage	+23 VDC
Tuning Voltage	-7 to -12 VDC Nominal (via IF coax)

RECEIVER

IF Input Frequency	70 MHz
IF Input Impedance	75Ω
IF Input Level	-50 to -20 dBm
IF Bandwidth	28 MHz Standard (other bandwidths available)
Threshold Level	Better than 8 dB C/N

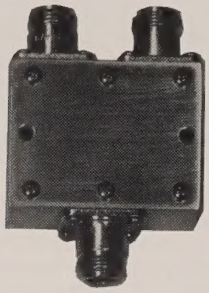
VIDEO SPECIFICATIONS

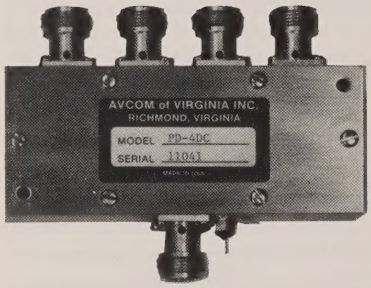
De-emphasis	CCIR 405-1, 525 Lines
Frequency Response	to 4.2 MHz
Dispersion Removal	43 dB Nominal
Output Level	1 Volt Peak to Peak
Output Impedance	75Ω
Output Polarity	Standard, Negative Sync (Polarity is internally reversible.)

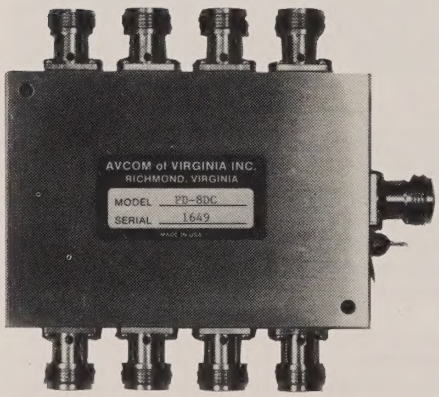
TUNABLE AUDIO SPECIFICATIONS

Subcarrier Frequency	4.5 to 8.0 MHz
Bandwidth, Dual	280 KHz Wide, 120 KHz Narrow
De-emphasis	75 Microseconds
Frequency Response	100 Hz to 15 KHz
Output Impedance	600Ω Balanced or Unbalanced
Output Level	1 Volt, Adjustable

MICROWAVE ACCESSORIES





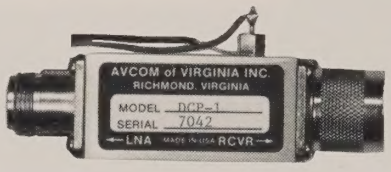


AVCOM 2, 4 and 8-WAY POWER DIVIDERS, WITH AND WITHOUT DC POWER BLOCK. MODELS PD-2, PD-4, and PD-8

AVCOM Power Dividers allow one LNA to feed two, four, or eight receiver installations.

SPECIFICATIONS

Frequency	3.7 - 4.2 GHz
Isolation	25 dB typ
VSWR	1.20:1
Insertion Loss	.25 dB typ
Impedance	50 Ω

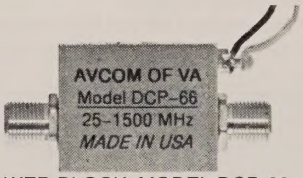


DC POWER BLOCK, MODEL DCP-1

AVCOM's DCP-1 is a 3.7-4.2 GHz DC Power Block for inserting or removing voltage on C-Band coaxial cables. Applications include inserting power on coax feed lines to power LNAs or line amplifiers, blocking DC voltage when multiple receivers are used on a single LNA, and providing DC protection to sensitive test and measurement equipment.

SPECIFICATIONS

Input Voltage	100 VDC max
Input Current	250 ma. max
Insertion Loss	.35 dB typ
Connectors	Type N-Female / Type N-Male



DC POWER BLOCK, MODEL DCP-66

AVCOM's DCP-66 is a 25 to 1500 MHz DC Power Block for inserting or removing voltage on IF coax feed lines. Typical applications include, inserting power on RG-59 coax to power a block converter, providing a test point to monitor a tuning voltage carried on a downconverter coax, and using an existing coax cable to carry power for some special purpose such as a relay switching or polarization control.

SPECIFICATIONS

Insertion Loss	1 dB
Flatness	+ 5 dB
Frequency Response	25 MHz to 1.5 GHz
Connectors	Type F

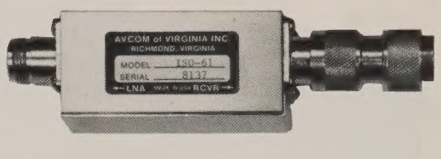
NEW!!!

HIGH FREQUENCY DC POWER BLOCK MODELS DCP-8 and DCP-14

AVCOM's DCP-8 and DCP-14 are DC Power Blocks for inserting or removing voltage coaxial cables in the .1-8GHz and .5-14GHz frequency bands, respectively.

SPECIFICATIONS

Frequency Response	
DCP-8	100 MHz to 8 GHz
DCP-14	500 MHz to 14 GHz
Connectors	Type SMA (Std)

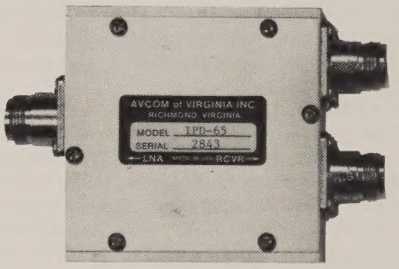


FERRITE ISOLATOR, MODEL ISO-61

AVCOM's Ferrite Isolator Model ISO-61 with 60 dB of isolation effectively prevents interaction between single conversion receivers.

SPECIFICATIONS

Frequency Bandwidth	3.7 - 4.2 GHz
Frequency Response	±.25 dB
Insertion Loss	.9 dB typ
Isolation	greater than 60 dB typ
Connector	Type N
Configurations	
1. Female - Female	
2. Female - Male	



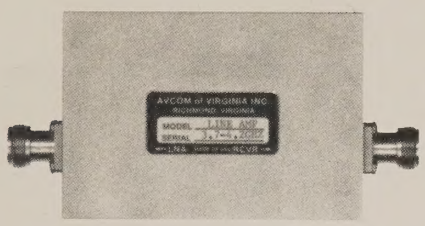
ISOLATED POWER DIVIDER, MODEL IPD-65

AVCOM's Isolated Power Divider, Model IPD-65 is the economical solution to the problem of using two satellite receivers with one LNA. The IPD-65 2-way power divider with ferrite isolators offers more than 65 dB of isolation between output ports, extreme reliability, and excellent 3.7-4.2 GHz signal performance. A feature unique to the IPD-65 is an LED indicator that allows verification of power to the LNA. Automatic feed line power switching and DC block circuits are included to simplify downconverter hook up.

Inherent reliability, quality materials, and careful design make the IPD-65 the component of choice for combining two satellite receivers.

AVCOM BRINGING HIGH TECHNOLOGY DOWN TO EARTH

MICROWAVE ACCESSORIES

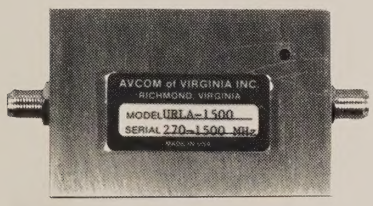


AVCOM 3.7 - 4.2 GHz LINE APLIFIER

Designed to amplify satellite signals in the 3.7 to 4.2 GHz range over long distances. The unit passes DC power for powering LNAs.

SPECIFICATIONS

Frequency Range	3.7 to 4.2 GHz
Gain	18 dB
Noise Figure	6 dB
DC Voltage	+15 to +24 VDC
Connector Type	Type N Female,50 Ω



UNIFORM RESPONSE LINE AMPLIFIER, MODEL URLA-1500

Designed to amplify downconverted satellite signals in the 270 to 1500 MHz range over long distances. The unit passes DC power for powering LNBs.

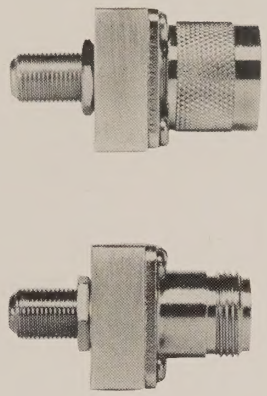
SPECIFICATIONS

Frequency Range	270 to 1500 MHz
Gain	20 dB
DC Voltage	+12 to +24 VDC
Connector Type	Type F Female, 75 Ω

ACTUATOR WIRE:

AVCOM stocks actuator wire with the following features: direct burial PVC jacket, overall clear mylar vapor barrier, soil resistant, sunlight resistant, flame resistant (UL), flexibility maintained at low temperatures, easy to work with, twisted pair on motor wires to reduce electrical interference. AVCOM actuator wire contains the following;

2-14 gauge	Suggested for use with DC motor drive.
2-22 gauge	Shielded with aluminum mylar foil. Suggested for use with motor drive sensor.



CONNECTORS:

ADP-1 is an adapter with type N-Male on one end and a type F-Female on the other. The adapter mates a type N-Female connector to a type F-Male connector.

ADP-2 is an adapter with type N-Female on one end and a type F-Female on the other. This adapter mates a type N-Male connector to a type F-Male connector.

Following Not Illustrated

UG-21 B/U Type N-Male , 50 ohm impedance, Teflon insulation, for RG-214 cable.

UG-23 D/U Type N-Female, 50 ohm impedance, Teflon insulation.

UG-27 C/U Type N, right angle, 50 ohm impedance, Teflon insulation.

UG-29 B/U Type N-Female to Female straight adapter, 50 ohm impedance, Teflon insulation, outside thread.

UG-57 B/U Type N-Male to Male straight adapter, 50 ohm impedance, Teflon insulation, inside thread.

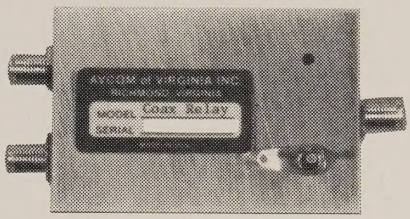
UG-204 C/U Type N-Male, 50 ohm impedance, Teflon insulation, for RG-217 cable.

UG-564 Type N plug to type C jack, 50 ohm impedance, Teflon insulation.

UG-572/U Type C-Female, 50 ohm impedance, Teflon insulation, "Quick Connect" for RG-214 cable.

UG-634/U Type C-Female straight adapter, 50 ohm impedance, Teflon insulation.

UG-707 A/U Type C-Male, straight plug, 50 ohm impedance, for RG-217 cable.



COAXIAL RELAY

Operates as an electrically powered coaxial AB switch in the 950 to 1450 MHz range.

SPECIFICATIONS

Frequency Range	950 to 1450 MHz
DC Voltage	+12 VDC
Connector Type	Type F Female, 75 ohm

3.7-4.2 GHz COAXIAL RELAY *(Not shown)*

Operates as an electrically powered coaxial AB switch in the C-Band range (3.7-4.2 GHz).

SPECIFICATIONS

Frequency Range	3.7-4.2 GHz
DC Voltage	+12 VDC
Connector Type	Type N Female, 50 ohm

CABLES:

AVCOM can meet your needs for TVRO feed line requirements. We carry a full line of cable for almost every application. Cables in stock include:

1. 3 Conductor 18 gauge shielded grey vinyl jacket control cable. Used to power and tune downconverter and LNA.
2. 8 Conductor 22 gauge grey vinyl jacket control cable. Used for remote control extension.
3. 10 Conductor 22 gauge shielded beige vinyl control cable.
4. 12 Conductor 22 gauge shielded beige vinyl control cable. Used for remote control extension.
5. RG-59/U 75 ohm coaxial cable with foam insulation, black vinyl jacket, copperbraid, copper center conductor. Used to connect downconverter to receiver.
6. RG-214 double shielded 50 ohm coaxial cable. Medium loss at 4 GHz. Primarily used for pigtails and short feed lines.
7. RG-217 50 ohm double shielded lower loss coaxial cable. Used between LNA and downconverter for medium length cable runs.

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